A KEY to CIVIL ARCHITECTURE; OR THE Universal *British* Builder.

CONTAINING

The PRINCIPLES and PROPERTIES of BUILDING clearly demonstrated, with Illustrations and Definitions both Theoretical and Practical; with a Dissertation on the SCIENCES appertaining thereto, as well as the Kindred Requisites of Strength, Convenience, Propriety, and Beauty.

ALSO,

A strict Enquiry into the present Manner of Building and Mode of Finishing, and how far the Taste is consistent with Symmetry and sound Reason:

WITH A

New Criterion, *or* Universal Estimator;

In which are considered the Quantity and Quality of Materials adequate for the Execution of any Building; their exact Value wheresoever appropriated; the real and universal Price assigned, proved by the Labour which is required to every Jobb; with practical Remarks on all the different Branches of a Building, especially on Joiners Works; where the most irksome and difficult Parts are considered and reduced to familiar Practice, by the most judicious and approved Methods.

The Principles, Properties, and Consequence of all Sorts of Stairs defined, both with respect to Plans and Execution, as well as the Manner of gluing up all Sorts of Hand-rails.

The Manner and Method of measuring all the different Artificers Works, as practised by the most eminent Surveyors, with their Prices to each Work.-----Also, the Masters Prices, and a Schedule of Prices for Task-Masters.

TO WHICH IS ADDED,

A Treatise of Arithmetic, Extraction of the Roots, Duodecimals, Mensuration of Superficies and Solids, round and square Timber, &c. with Explanations and Reasons for the Rules.

By THOMAS SKAIFE, P. A.
CARPENTER AND JOINER.

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LONDON:

Printed for the AUTHOR, by I. MOORE and Co. Letter-Founders and Printers, in *Queen-Street*, near *Upper-Moorfields*.

M DCC LXXIV.

V

A

KEY to CIVIL ARCHITECTURE;

OR THE

Universal British Builder.

CONTAINING

The Foundations and Proportions of BUILDING clearly demonstrated, with Illustrations and Definitions both Theoretical and Practical: with a Dissertation on the several applications thereto, as well as the Natural Requisites of Strength, Convenience, Regularity, and Beauty.

ALSO,

A Brief Enquiry into the present Manner of Building and Mode of Finishing, and how far that Taste is consistent with Symmetry, and Name Bearings.

WITH A

New Criterion, or Universal Estimator;

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M.DCC.LXXIV.

TO THE

READER.

THE following sheets, now offered to the Public, were the produce of my leisure hours. How far I have succeeded in the different matters I have treated upon, I leave to the candor and judgment of a critical and discerning world, desiring no approbation, but what results from the merit of the work; humbly hoping, that no one will be too anxious to censure any point, before he hath well weighed the consequences of it.

If any person should traduce me for discovering the secrets of the building branch, relative to the prices of work, I must inform him, that I considered that as the first rudiment of my plan, in order

to give every journeyman (which I think he has a right to) a view of the principles and profits of his buſineſs.

I humbly dedicate my endeavours to all in the building branches; and have the honour to be their

Moſt humble, and

moſt obedient Servant,

Thomas Skaife.

A
KEY
TO
CIVIL ARCHITECTURE.

INTRODUCTION *to* MECHANICS.

ALL the liberal arts, and various ſtudies, which the buſtling world are daily in purſuit of, may be generally compriſed under the following heads, viz. *Natural*, *Divine*, and *Artificial*.

To the firſt of theſe is reducible, not only the government of this great Univerſe, but the knowledge of the uſual cauſes of Providence in the frame of every created thing.

To the ſecond may be referred, the Practice of all thoſe virtues, which may advantage our minds in the ſearch or enquiry after their promiſed happineſs.

To the laſt do belong all thoſe inventions, whereby Nature is any way quickened or advanced in her defects: theſe artificial experiments being (as it were) but ſo many eſſays, by which men do naturally attempt to relieve themſelves from the firſt general curſe inflicted upon their labours. Though different

different the operations, 'tis ſtill one cauſe; whether a man is emulous for honor, wealth, or fame:—Though I muſt confeſs, none of theſe motives induced me to the following undertaking, yet my readers will hardly be perſuaded, that I had no other view in the attempt, than an earneſt deſire to propagate the fruits of my induſtry for the univerſal benefit of mankind. However, if I may be allowed to alledge my reaſons, I muſt affirm they are centered ſolely in the laſt obſervation; as, I hope, my endeavours and examples in the following works will plainly evince.

I am far from the opinion of the ancient philoſophers, who eſteemed it a great part of their wiſdom to conceal their learning from vulgar apprehenſion and uſe, thereby the better to maintain it in its due honor and reſpect: and therefore did they generally veil all their arts and ſciences under ſuch myſtical expreſſions, as might excite the people's wonder and reverence; fearing leſt a more eaſy and familiar diſcovery might expoſe them to contempt. Hence was it, that the ancient mathematicians did place all their learning in abſtracted ſpeculation; refuſing to debaſe the principles of that noble ſcience into mechanical experiments: inſomuch, that thoſe very authors amongſt them, who were moſt eminent for their inventions of this kind, and were willing, by their own practice, to manifeſt unto the world thoſe artificial wonders, that might be wrought by theſe arts, as *Archimedes*, *Dedalus*, &c. were, notwithſtanding, ſo much infected with this blind ſuperſtition, as not to leave any thing in writing concerning the grounds and manner of ſuch operations; by which means poſterity unhappily loſt, not only the benefits of thoſe peculiar diſcoveries, but, for many centuries, the proficiency of thoſe arts in general:

neral: for when once the learned men did forbid the reducing them to particular uſe, and vulgar experiments, others did therefore refuſe thoſe ſtudies, as being but uſeleſs and empty ſpeculations: whence it came to paſs, that the ſcience of geometry was ſo univerſally neglected, receiving but little or no addition for many hundred years together. The divine *Plato* is reported to have been a ſtickler for this fooliſh opinion; adviſing all his followers from proſtituting mathematical principles unto common apprehenſion or practice; and, in this ſuperſtition to philoſophy, rather choſe to deprive the world of all his uſeful and excellent inventions, than to expoſe that profeſſion to the ignorant vulgar: but his pupil *Ariſtotle* (as in many other particulars, ſo likewiſe in this) did very juſtly oppoſe him; and became one of the firſt authors that hath written any practical diſcourſe on theſe arts. Since him, many other authors of eminence have left maſterly works, chuſing rather a general benefit, than the hazard that might accrue from the vain, and groundleſs diſreſpect of theſe formal bigots; rightly preferring the reality and ſubſtance of public good, before the ſhadows of ſome retired ſpeculation, and ingrate vulgar opinion.

LECTURE I.

Of MECHANICS.

THE word *Mechanics* is thought by ſome to be derived from the *Greeks*, intimating the efficacy and force of ſuch inventions, as elucidate geometrical rules for demonſtrating motion, and the effects of powers, or forces, in removing the matter of bodies; or elſe becauſe theſe arts are ſo full of

pleaſing

pleasing variety, that they admit not of sloth or weariness. Indeed, according to the ordinary signification of the word, it is used in opposition to the liberal arts; whereas, in propriety of speech, those arts and employments may alone be called illiberal, which require some bodily labour, divested of causes and speculation; as sawyers, shoe-makers, taylors, &c. And on the contrary, that discipline, which teaches and discovers the general effects and properties of things, may truly be esteemed as a species of philosophy.

But here it should be observed, that this art is usually distinguished into a two-fold kind, viz. *rational* and *manual*. The first is that, which treats of those principles and fundamental notions which may concern these mechanical practices. The latter doth refer to the making of all these instruments, and the exercising of such particular experiments in architecture, &c. and, familiarly speaking, may be termed as theory and practice; both which I mean to treat of in the following sheets. The first of these may properly be called liberal, as deserving the thoughts of men of erudition; because springing from the honourable parentage of geometry and natural philosophy.

Not even the pursuit of Rhetoric and Logic do more adorn the mind, than a thorough knowledge of Architecture, and Mechanic powers and practices enlighten the understanding; and, therefore, are they well worthy to be entertained with much greater respect, than they commonly meet with in these luxurious times.

The mechanical faculties, by which all experiments are tried in removing the matter of bodies, are generally reckoned to be six—the Balance, the Lever, the Wheel, the Pulley, the Wedge, and the Screw;

Screw; unto some of which every divisible, impenetrable, and passive substance, that hath extention and resistance, which are the properties of all kinds of bodies, must be affected on their universal principle of gravity; gravity being that force, by which bodies are carried or tend towards the center of the earth, and which may be said to be in proportion to the quantity of matter they contain.

But, for the better distinction, and more clear discovery of these mechanical faculties, as they are of the greatest utility to all students of Architecture, I shall speak of them severally.

LECTURE II.

Of the BALANCE.

THE first invention of the Balance is commonly attributed to *Astrea*, who was therefore deified by the title of *The Goddess of Justice*.

The particulars of the Balance are so commonly known, and of such easy and familiar experiments, that they will not need any large explanation. The chief end of it is for the distinction of several ponderosities; for the understanding of which, we have only to note, viz. that, if the sides of the Balance, and the weights at the end of them, be mutually equal, then the beam will be in an horizontal or level situation; but, on the contrary, if either the weights alone be equal, and not their distances, or the distances alone, and not the weights, then the beam will accordingly decline.

From these grounds, rightly apprehended, it is easy to conceive how a man may find out the just proportion of a weight, which, in any point given, shall equiponderate to several weights given, hanging in several places of the beam.

Within the power and circumſcription of the Balance, many ingenious enquiries may be made; ſuch as meaſuring the weight and force of blows, the ſtrength of ſtrings, or other oblong ſubſtances, the diſtinct proportion of ſeveral metals mixed together, and the different gravities of divers bodies in the water, from what they have in the open air. But, as theſe things are foreign to the preſent deſign, I ſhall conclude, without farther eſſay on the Balance, with this obſervation, that whatever geometrical definitions may be in any wiſe serviceable, relative to the Balance, I ſhall ſpeak of them in the different parts of practice, as they occur; eſpecially of geometry ſtairs.

LECTURE III.

Of the Lever.

THE ſecond mechanical faculty is the Lever, the firſt invention of which is generally given to *Neptune*, the *God of the Sea*, and repreſented by his trident.

The properties and principles of this powerful and uſeful inſtrument bear almoſt the ſame proportions with the Balance, only with this difference—mark the following

EXAMPLE.

As the weight is to an equivalent power, ſo is the diſtance betwixt the weight and the center unto the diſtance and the power; and ſo reciprocally. Or thus—The power that doth equiponderate with any weight, muſt have the ſame proportion unto it, as there is betwixt their ſeveral diſtances from the center or fulciment.

The

The meaning of the aforeſaid doth import thus much; that the power at the end of the Lever muſt bear the ſame proportion to the weight to be ſuſtained, as the diſtance from the fulciment to the power you bear doth from the fulciment to the weight:—for inſtance, if your Lever is nine feet long, and the fulciment at one foot, the proportion will be as eight to one; for, ſuppoſing the weight eight hundred, one hundred borne upon the end of the Lever, at eight feet, would equiponderate, and be adequate to the weight. The ground of which maxim is, the fulciment at one foot, in this proportion, being the center of gravity.

It muſt be obſerved, that all the varieties of motion in inanimate bodies, are ſubject to the forces impreſſed; and therefore it follows, if a body be abſolutely at reſt, and unfurniſhed with any moving principle, it muſt of courſe continue ſo, till acted upon by ſome external power. When a body is put in motion, it hath no power within itſelf to make any change in the direction of its courſe; therefore muſt move in proportion to the power impreſſed.

There is not a more uſeful, nor a more extenſive inſtrument than the Lever, nor any ſo familiarly reduced to practice. It is reported of the great *Archimedes*, that, with this ſimple faculty, he propoſed to remove the greateſt conceivable weight with the leaſt conceivable power; and moreover, if he did but know where to ſtand and take his fulciment, he could remove the world—all this great maſs, or globe of ſea and land; which attempts, though they were altogether above the vulgar apprehenſion or belief, yet his acts had been ſo very extraordinary, and in compliance with an edict made by the king of *Syracuſe*, (to believe whatever *Archimedes* ſhould

 affirm)

affirm) they were obliged to reconcile this extravagant proposition; though it might be easy to demonstrate the geometrical truths of these strange assertions, where is the use of it's supposing them proved by the mechanical faculties? Such grounds, though palpable to the weakest capacity, could exist only in fancy, or idea, being far beyond the executive power of man to effect. Therefore the thought was diabolical, because impracticable:—It is nevertheless certain, if there was the greatest conceivable weight, with the least imaginable power—suppose so small as the weight of one man; if we conceive the same disproportions between their several distances, as in the former observation, from the fulciment to the center of gravity, they would both equiponderate: and if the distance of the power from the center, in comparison to the distance of the weight, were but any thing more than the heaviness of the weight is in respect to the power, it may then be evident, from the former example, that the power would be greater than the weight, and consequently able to move it.

LECTURE IV.

Of the Wheel.

AMONGST the variety of artificial motions, those are of most use and pleasure, to which, by the application of some continued strengh, there is bestowed a lasting motion. These we may properly call self-movers, because the motions of such inventions are actuated or caused by something which belongs to their own frame, or at least by some external inanimate agent; as mills by wind and water; clocks, watches, or other engines made of wheels, by weights, springs, &c. It

It would be too elaborate to illustrate the extension of this mechanic faculty, otherwise than what may be useful to the present design. I shall, therefore pass over what may be effected by its subtlety, in every respect, but its power in removing the matter of bodies.

The Wheel, relative to power, is in every respect equal with the Lever; but the force of this faculty may be more conveniently understood by the multiplication of several wheels together, with nuts belonging to each of them. The full effect of this invention cannot be better explained than thus;—As the nut is to the wheel, (which may be as one to ten) so is the number of wheels and nuts to an equivalent power. One of our ordinary jacks for roasting meat (which consist but of three) fully shews what may be executed by a number of these movers: for, if the fly or balance, in comparison to its axis, be but as the proportion of wheels to the nuts, *viz.* ten to one, and the whole proportionable to the weight, 'tis evident that, if the weight was three hundred, a small string at the balance or fly would easily draw it up; for if the weight was three hundred, *viz.* 336lb. or even 1000lb. the fly need not be more than as one to a thousand; for the first axis is to be but one tenth part of its wheel; and therefore, though the weight be a thousand pounds, yet unto a power that hath this advantage, it is but as a hundred at the second wheel; and in this proportion still diminishing, at the third wheel it is but ten, and at the fly but one; so, if a man has a string that will draw one pound, it is palpable he may effect this weight: and so of any other power, let the weight or magnitude be ever so great; it is but adding more wheels and nuts, adequate to the above proportion.

Upon

Upon this principle was the famous engine extolled ſo by *Stevenius*, and preferred by him to all *Archimedes's*: it conſiſted of wheels and nuts, tho' poſſibly more conſiderable in number, and might bear a greater proportion. Upon this principle an author tells us, that if there we an engine with 12 wheels, each of them with teeth, as alſo the axes or nuts which belong to them, ſays he; if the diameter of theſe wheels were unto each axis as a hundred to one; and if we may ſuppoſe the wheels to be ſo placed, that the teeth of the one might take hold of the axis which belongs unto the other, and that the axis of the handle (made to work it) may turn the firſt wheel, and the weight be fixed to the axis of the laſt, he could with eaſe remove the greateſt conceivable weight in the world.

It appears to me the moſt unaccountable thing in nature, how any man, or body of men, can buoy themſelves up with impracticable notions: it is true, that explications and geometrical definitions may be rendered of all kinds of local motion, and even ſo facile and obvious, that an ordinary artificer may ſufficiently underſtand them, and yet not all the men in the world be able to execute them. Tho' this may ſeem a paradox to many, I hope to prove it clearly by example; notwithſtanding *Ariſtotle* has endeavoured to define, that there is no conceivable weight that may not be removed by theſe wheels, even as much acted as can be fancied by imagination.

It remains now, in order to make a perfect diſcovery of the truth of what many authors have aſſerted, concerning the removing the world, the drawing up by the roots the ſtrongeſt oaks, and many more of the like extravagant affirmations, to enquire into the nature of artificial motion—I mean

ſlowneſs

ſlowneſs and ſwiftneſs; for, without a right underſtanding of theſe, a man will be expoſed to many abſurd miſtakes, in attempting thoſe things, which are either in themſelves impoſſible, or elſe not to be performed by ſuch means as are applied to them. I think I may ſafely affirm, that many, if not moſt, miſtakes in theſe great mechanical deſigns, do ariſe from a miſapprehenſion of that difference, which there will be between the ſlowneſs or ſwiftneſs of the weight and power, in compariſon to the proportion of their ſeveral ſtrengths.

If it were poſſible to contrive ſuch an engine, whereby any conceivable weight might be moved by any conceivable power, both with the ſame brevity or ſpeed (as it is with thoſe things immediately ſtirred by the hand) the works of Nature would be then too much ſubjected to the power of Art, and men might be encouraged, with the builders of *Babel,* to ſuch extravagant deſigns, as would not become a created being; and, therefore, the wiſdom of Providence hath ſo confined theſe human arts, that what any invention hath in the ſtrength of its motion, is abated in the ſlowneſs of it: for it muſt be obſerved as a general rule, that the ſpace of time or place, in which the weight is moved, in compariſon to that in which the power doth move, is in the ſame proportion as they themſelves are to one another; ſo that if there be any great difference betwixt the ſtrength of the weight and the power, the very ſame kind of difference will there be in the ſpace of their motion. If the power be unto the weight but as one to an hundred, then the ſpace, through which the weight moves, will be an hundred times leſs, and conſequently the motion of the weight an hundred times ſlower than that of the power.

If

If we consider an instrument of twelve wheels, as before-mentioned, made proportionable in strength for any imaginable weight, we should then find that the motion of it must be considerably slower than the heavens are swift: for, if we suppose the windlass to such an engine (prepared to set the whole in motion) to be turned 4000 times in an hour, yet in ten years space the weight would not be moved one hair's-breadth, nor an inch in a thousand years: the truth of which we may more easily conceive, if we consider the frame and manner of a twelve-wheeled engine: suppose in each axis or nut there were ten teeth, and on each wheel a thousand; then the windlass of this engine must be turned one hundred times before the first wheel, reckoning downwards, could be moved round once, and ten thousand times before the second could finish one revolution; and so through the whole twelve wheels this multiplied proportion.

I will now appeal to every reader, of common reason, whether such attempts or expressions can be more than the incoherent fumigations of a distempered brain! Notwithstanding, the beauties of mechanical manœuvres are as instructing as entertaining, when they are reduced to familiar practice, but when once prostituted, or stretched beyond the power of art, they no longer can be considered as parts of the science, because they only exist in notion.

Not much unlike such extravagant thoughts as these, was that of the famous *Grecian* architect, who did propound to *Alexander the Great*, to cut the large mountain *Athos* in the form of a statue or figure of a man, which in his right hand should hold a town capable of ten thousand men, and in his left a vessel to receive all the water that flowed from the

the ſeveral ſprings in the mountain; but whether *Alexander*, in his ambition, feared that ſuch an idol might have more honour than he himſelf; or whether, in his good huſbandry, he thought ſuch a work would coſt him more money than the conquering the world; or whatever elſe, he refuſed to undertake it: but if he had conſented to ſuch an unreaſonable attempt, (though in contradiction to the opinions of all mankind) I dare affirm it never could have been executed.

LECTURE V.

Of the PULLEY.

THE Pulley is of ſuch ordinary uſe, that it will not need much, nor any particular deſcription. The chief parts of it are divers little rundles, that are moveable about their proper axes: theſe are uſually divided according to their ſeveral ſituations, into the upper and lower. The lower pullies only do give force to the motions. If we ſuppoſe a weight to hang upon any of the upper rundles, it will then require a power, that in itſelf ſhall be fully equal for the ſuſtaining it.

The diameter of a pulley, when fixed in a ſtate of motion, is as a proper beam or balance hung upon its center: therefore the power muſt be adequate to the weight, in the ſame ſtate as if the power and weight were faſtened by two ſeveral cords, at the end of the balance. Now all the upper pullies being of one and the ſame nature, it muſt neceſſarily follow, that none of them do in themſelves conduce to the eaſing of the power, but only for the greater conveniency of the motion; the cords by this means being more eaſily moved than otherwiſe they would.

If the weight to be ſuſtained be above the pulley, as in all the lower ſort it is, then the power that ſupports it need be but half ſo much as the weight itſelf. Let the diameter of a lower pulley, on whoſe center the weight is faſtened, one end of the cord being tied to a hook, there will be but half of the weight to ſuſtain; for the hook in this caſe is the ſame as if held up with a ſtring, with one end in each hand, upon a proper balance; and this ſubduple proportion will ſtill remain, though an upper pulley were joined to the lower. The upper pulley alone doth not abate any thing of the weight: it is the ſame thing, whether the half-weight is ſuſtained equal to the hook, by which one end of the cord is faſtened, as the weight is altered by the lower pulley alone. Now, as one of the lower pullies doth abate half of that heavineſs which the weight hath in itſelf, and cauſe the power to be in a ſubduple proportion unto it, ſo two do abate the half of that which doth remain, and cauſe a ſubquadruple proportion between the weight and the power; three a ſubſextuple; and ſo on to as many as may be required: for they will ſtill diminiſh the weight according to this proportion. Suppoſe the weight in itſelf to be 1000lb. the applying it to one of thoſe lower pullies will make it but 500; two of them but 250; three of them 125, &c.

It is not material to the force of this inſtrument, whether the rundles of it be big or little; if they be made equal to one another, in their ſeveral ſtations. But it is moſt convenient, that the upper ſhould each of them increaſe as they are higher; becauſe by this means the cords will be kept from tangling: theſe pullies may be multiplied according to ſundry ſituations. By theſe examples an invention is eaſily formed, for a man to draw himſelf up to any

conceivable

conceivable height, and familiarly reduced may be of much ſervice for particular uſes, when occaſion requires a reparation to ceilings of towers, domes, cathedrals, &c. and this may be effected with ſo little trouble and expence as two pullies, one above and another below; to the upper one muſt be fixed a hook, and hung at the top, which may be done on the outſide; the end of the cord fixed to the center of the top pulley; and put firſt round the bottom rundle, then the top, the other end of the cord a man may have in his hand to draw himſelf up by, or to any machine that he may require for his tools, &c.—To the execution of this will require but little more than half his weight, or if the pullies were multiplied, it may be done with half that force, and ſo on according to the forementioned proportions.

From what hath been ſaid of pullies, it is eaſy to conceive, from their natural effects what great performances might be wrought by theſe faculties being inſtruments of infinite ſtrength: It is reported of *Archimedes*, that with an engine of pullies to which he applied only his left arm he lifted up 5000 buſhels of corn at once; and drew up a ſhip with all her lading upon dry ground; and all with a threefold pulley.—But herein I muſt beg *Archimedus's* pardon for telling him he was under a grand miſtake: for it is not poſſible that theſe alone ſhould ſerve for the motion of ſuch a weight; becauſe ſuch an engine can but make a ſubſextuple, or at moſt a ſubſebtuble proportion, between the weight and power: which is by far too little to reconcile the ſtrength of a man to ſuch ponderoſities.—How many were eaſy to find out, if we did but know the weight of thoſe ancient meaſures; ſuppoſing them to be the ſame with our Engliſh buſhel, which weighs 64 pounds: the whole would then amount to 320,000; half of

which would be lightened by the first pulley, and half of the remains by the second; and so on in this subduple proportion. And if we do but consider a man's hand to be as 50 pounds weight, it will easily be demonstrated, and will take at least ten or twelve pullies to effect it.

LECTURE VI.

Of the Wedge.

THE first mechanical faculty is the Wedge, which is a well known instrument, and is of the greatest utility in niedling up old houses, cleaving of wood, &c. The efficacy and great strength of it may be resolved and particularized,

First, by the form of it,

Secondly, by the manner whereby the power is impressed upon it; which is by the force of blows; and is called percussion.

First, the form of it represents two leavers; and is a general rule, that the more acute the angles are, so much more easy will their motion be; the force being more easily impressed, and the space wherein the body is moved being so much the less.

The second particular whereby this faculty hath its force, is the manner whereby the force is impressed upon it; which is by a stroke or blow. The efficacy of it doth far exceed any other force: for though we suppose a wedge to be laid or fixed in a piece of timber (in a position for cleaving) and pressed down with ever so great a strength, nay though we were to apply the force of the other mechanical instruments, the screw, pulley, &c. yet the effect would not be adequate to a blow. The true definition of this is perhaps one of the greatest subtilties in nature, nor is it in my opinion fully explained by any author

thor who has undertaken the resolution of it: and yet to me seems no other than the celerity of the blow emitted to effect it.

. Those who attribute it to swiftness alone, have not given it a proper thought; for if so, a blow with a light weapon would exceed any other force. According to this, how comes it to pass that an arrow or bullet discharged near at hand, is yet notwithstanding much less than at a proper distance; when the violence whereby they are carried is most fresh, and in all probability the motion most swift? I think the first and greatest consideration is the quality and weight of the instrument by which the blow is given; secondly the space or distance through which it passes.

And First, If the instrument by which you mean to effect the motion, is not proportionable to the strength or force required, the swiftness or rapidity of the blow will not serve to accomplish it. And Secondly, If the space or distance through which the force must pass be not sufficient to acquire the requisite celerity, it will add nothing to the purport, supposing the sledge or instrument contained a double proportion of weight; and therefore may be reduced to the following example: As the weight of the instrument is to the power of the wedge, so is the celerity of the blow to the distance required to effect it.

LECTURE VII.

Of the SCREW.

THAT which is usually recited for the sixth mechanical faculty is the Screw; which may be called a kind of wedge, multiplied or continued round

round by an Helical revolution about the body of a cylinder; receiving its motion not from a ſtroke, but a leaver or handle at one end of it; and is uſually diſtinguiſhed by the names of male and female. The male is the fore-mentioned ſcrew; the female is the nut which receives it. The quality of this faculty far exceeds any of the reſt, for that uſe to which it is generally applied; as, in printing, extracting and ſqueezing out the juice of fruits, &c. and in the execution of this inſtrument the ſtrength of one man will be more forcible than the weight of a whole mountain. It is alſo uſed for lifting and raiſing great weights, and is much more practicable than any inſtrument made of wheels, pulleys, &c.

The great advantage of this faculty above the reſt doth conſiſt chiefly in this; the other inſtruments do require ſo much ſtrength for the ſupporting of the weight to be moved as may be equal to it, beſide that other ſuper-added power whereby it is out-weighed and moved; ſo that in the operation by theſe a man does always ſpend himſelf in a continued labour. Thus for example:

Any weight that is lifted up by a wheel or pulley, will of itſelf recline, if there be not an equal power to ſuſtain it: but in the compoſure of the ſcrew, this inconvenience is perfectly remedied; for ſo much as is communicated unto this faculty from the power that is applied to it, is ſtill retained by the very frame and nature of the inſtrument itſelf; ſince the motion cannot return, but by the handle of the leaver which effected it; ſo that all the ſtrength of the power may be employed in the motion of the weight, and none ſpent in ſuſtaining of it. The principal defect of the ſcrew is, that in a ſhort ſpace it will be worked to its full length; and then it can-

not

not be of further uſe for the continuing of the motion; unleſs (as before obſerved) it be returned back by the ſame inſtrument that did work it.

Though this moſt noble and facile of all mechanic faculties is not ſo much as mentioned by ſome of the ancients, eſpecially *Ariſtotle*; yet I cannot help thinking, that moſt of the wonders performed of old may chiefly be attributed to the execution of this inſtrument, becauſe no other invention could be ſo applicable to time, as what might be made and contrived by certain ſcrews.

Amongſt the *Jews* we read of *Solomon*'s temple, which for its ſtate and magnificence might have been juſtly reckoned amongſt the other wonders of the world: we read of pillars of braſs eighteen cubits high, and twelve cubits round, great and coſtly ſtones for the foundation of it. *Joſephus* tells us, that ſome of them were forty-five cubits long: and again he mentions the famous towers built by *Herod*, wherein every ſtone was of white marble, twenty cubits long, ten broad, and five thick; and which was the greateſt wonder, the old wall itſelf ſtood upon a ſteep riſing ground, and yet the hills upon it, on the tops of which theſe towers were built, and were above thirty cubits high; ſo that it is ſcarce conceivable by what ſtrength ſo many ſtones, of ſuch great magnitude, were conveyed thither.

Amongſt the *Grecians* we read of the *Epheſian* temple dedicated to *Diana*, wherein there was an hundred and twenty-ſeven columns, made of ſo many ſeveral ſtones, each of them ſixty feet high, being all taken out of the quarries of *Aſia*.

There were beſides at *Rome* ſundry obeliſks made of ſo many ſtones all entire, ſome of them 40, ſome 80, and others 90 cubits high; the chief of them

them were brought out of *Egypt*, where they were dug out of certain quarries, and there wrought into form, and afterwards, not without incredible labour and infinite charge, brought to *Rome*.

Alſo about two hundred years ago there was erected an old obeliſk, which had been dedicated to *Julius Ceſar:* it was one intire ſtone, being a kind of ſpotted marble; the height of it was one hundred and ſeven feet; the breadth of it at the bottom twelve feet; at the top eight feet: it was removed at the charge of Pope *Sextus* the Fifth from the left ſide of the Vatican, to a more eminent place. The moving of this obeliſk is celebrated by many writers; all of them ſpeaking of it with great wonder and praiſe.

The executing in former days ſuch great wonders may ſeem to infer, that theſe mechanical arts are now loſt amongſt the many other ruins of time; which, notwithſtanding, cannot by any means be granted, without much ingratitude to the preſent age.—I believe if a proper examination were made into the merits of ſome now living, I am perſuaded we ſhould not find it a want of method that diſables them; but becauſe we have not either the ſame materials, or motives to attempt ſuch works, or the means to effect them, as the ancients had.

The preſent age is much more active than the ancients; every man now finds ſo much buſineſs for the preſent, that he has not leiſure to trouble himſelf with things that can never be of uſe to him, and therefore in many reſpects there is a great diſproportion betwixt the incitements of thoſe former times, and the preſent age with regard to ſuch magnificent attempts. And moreover, as we differ much in the motives, ſo likewiſe do we in the means of effecting them.

There

There was in those remote days more leisure and opportunity both for the great men to undertake such works, and for the people to perfect them: whereas the world is grown more politic and therefore more troublesome: every great man having other private and necessary business about which to employ his time and fortune. And so likewise for the common people, who living then more wildly, without being confined to particular trades and professions, might be more easily collected about some famous employments: whereas now, if the king wanted to raise an army, it would not be possible to gather half the number of men that were formerly employed about these magnificent buildings.

We read of thirty six hundred thousand men that were busied for twenty years in building one of the Egyptian pyramids; and of a million of men that were as long in building another of them; and about the carriage of one stone twenty days journey, there were for three years together two thousand chosen men directors, besides many other under-labourers.

In the building of *Solomon's* temple there were threescore and ten thousand that bare burdens, besides fourscore thousand hewers in the mountains. Supposing every one of these but to carry a load, there were enough to make a large mountain.—The *Ephesian* temple, spoken of before, was built at the expence of all *Asia* joining together; the 127 pillars were made by so many kings, according to their several successions; the whole work not being finished in less time than two hundred and fifteen years.

The abundance of wealth which was then engrossed into the possession of some few particulars being now diffused amongst a far greater number, there is now a greater equality amongst mankind;

and the flourishing of arts and sciences hath so stirred up men's natural nobility, and made them of such active and industrious spirits, as to free themselves in a great measure from that slavery which those former and unpolished nations were subject to. From all which considerations it does not infer any defect of art in these latter days. For my own part, I conceive it as easy to demonstrate the mechanical arts in these times to be so far beyond the knowledge of the remote ages, that had we the means the ancients had, we might effect far greater matters with half the labour, and one tenth part of the expence.

LECTURE VIII.

Of Building *in* General.

THOUGH the word Building in a restrained sense only alludes to the erecting or raising of an edifice; yet the means and manner of such execution, must be effected by the power of science, well digested in the mind of the conductor. For to build well, depends not only the sciences of Geometry and Architecture, but a thorough knowledge of mechanic powers in general; as also Hydraulics, or the art of conveying water by the law of motion, through pipes or engines, as may be requisite both for use and convenience.

The art of building, which is founded on the requisite of some of the noblest sciences, requires a greater application, and more enlarged judgment, than is usually considered: therefore the term Builder is frequently made use of, and misapplied by some who do not understand it. For a man to be proficient in Building, in the first place he should

have

have a knowledge of all the materials to be ufed, both as to quality and quantity, as well as all the arts of the different branches thereunto belonging: and many more appertaining confiderations, plainly to elucidate thefe requifites as far as may be neceffary with common practice, in civil Architecture; is the fubject of the following fheets: and becaufe I wifh not to take up my reader's times with a defcription of what he has to obtain, without an illuftration of the principles themfelves, I fhall proceed in the firft place, to explain the principles of Building in general.

In every ftructure or edifice there are four things to be confidered, viz. ftrength, convenience, propriety, and beauty; without which not the choice of any quantity of materials whatfoever will in any wife contribute to the purpofe; as nothing can be erected with any certainty, that is wanting in the above properties. Therefore it will be eligible to the defign, not only to enquire into the nature of thefe great confiderations, but alfo to elucidate their ufe, and point out fuch defects as the unexperienced workman may be liable to.

LECTURE IX.

Of STRENGTH *in* BUILDING.

THE firft quality to be confidered in all buildings is Strength, which directly alludes to the ground-work, in every refpect and part; which a builder fhould have a firm affurance of, before the firft ftone or brick is laid: for whatever errors may be committed in a building cannot in any wife be fo pernicious as a certain defect in the foundation. Therefore it behoves every man, who is principally

concerned in an edifice, to look and inſpect into this great particular himſelf: being the baſe of the fabric, he ſhould be aſſured of its natural ſolidity. If the ground is faulty, in this laſt obſervation it will be neceſſary to ſupply this natural defect by the power of art, which may be done equal to any ſtrength required.

A natural foundation is that which may be built upon without the aſſiſtance of piles, timber, plank, &c. There are different ſorts of ground which may be built upon, and all equally good; ſuch as ſtone, clay, gravel, and chalk. Theſe, if the foundation is of ſize proportionable to the weight to be ſuſtained, will anſwer all the purpoſe.

An artificial foundation is that which is obliged to be made when the ground is looſe, rotten, or otherwiſe defective, by the help of piles or planking, and muſt be indifferently uſed according to the builder's judgment. If your ground is a looſe ſand, and ſtands upon water but a ſhort ſpace from the ſurface of the ground, or floor of the cellars, (if ſuch are built) it will be neceſſary to drive piles all along the different foundations, as cloſe as they can ſtand, eſpecially at all angles, quoins, and chimneys. With regard to the length of the piles, they muſt always be regulated according to the ſtrength or body of the earth, and the weight and magnitude of the ſuperſtructure. — For my own part, I would always chooſe to make piles of ſuch length as might reach to a ſolidity of ſoil. The ſcantling of piles may be as 1-14th part of their length. With regard to inner walls, it may not in every caſe be required to drive piles quite cloſe all along, but at three, four, or five feet apart; between which lay bridgings of oak and planking upon the whole.

There are ſome ſorts of ground where planking alone

alone may do, and not of consequence sufficient to be trusted without. In such cases the following method must be adhered to.

First, Level the ground at the bottom of the trench, and at every quoin, and betwixt at the distance of 3 feet lay bridgings of oak the whole width of the foundation. Between and level with the top of those lay bricks or stones, and planking of 3 or 4 inches thick, to cover the whole; and on them proceed, observing to bed well the planking with good lome, that the planking may lay solid all along, and likewise particularly level.

The benefits that arise from a level foundation are, I hope, obvious to every professor of building: for it is not only a guide to keep in that state all the way up, but a shrewd maxim, that when this example is strictly adhered to, (and the materials of a proportional weight) that its bearings upon the ground are equal; and if any settlement should ensue, it may be every where alike.

With regard to inner walls, it is highly requisite that the like care be taken; for a sure and level foundation is of as much consequence in them as in the outward walls; and though they will require much less, yet must they be secured in proportion to their several weights: for if settlements should happen within the house, the whole mass of decorations will be disconcerted and rendered defective to every eye.

The foundation being secured, we are to consider the other appurtenances of strength, viz. the walls, centring-groins, floors, bond-timber, lintels, discharging-pieces, tassels, plates, girders, roof, tie-beams, &c. which must all bear a proportion to one another, and in every respect adequate to the whole.

And, first, of walls, whose great principle of strength lays in the peculiar cause of their erection, which is to support a certain weight to be appropriated, which of course must be made sufficient for the purpose intended. Therefore in order to reduce this system to a certainty, we must first be acquainted with the height and width of the structure, by which means we shall be able to fix a standard for the thickness of walls in proportion to their height. But as this last observation comes within the limits or rule of propriety, I shall finish this lecture with the following observations, viz. That after the foundation is secured, to continue this quality of strength the walls must be all built perpendicular; for then they are in their full positions of strength. The timbers must be all of sufficient scantlings, proportionable to the size of the building, and all have sufficient lengths of bearings in the walls, the bond-timbers all bound in the angles and fixed, till the roof is on, in one continued chain round the building; the girders all layed upon piers if possible, with binding pieces of timber underneath, and centers of brick turned over the tops of them; and if the girders are of great lengths they must be trussed.

The roof must be so contrived that all the walls may bear a proportionable share, neither too heavy nor too light. If too heavy, the lateral pressure of the raftors will tend to shove out the walls: if too light, it must of course be in danger of every storm. The raising-plates must be well tied at the angles, and the whole building secured at proper places with tie-beams, &c. And to crown the whole property with strength, the walls should have sufficient time in building, lest the super-incumbent weight crush the

the work underneath, and cause premature settlements, the sure way to ruin and destruction.

LECTURE X.

Of Convenience *in* Building.

THE word Convenience hath an extensive meaning, and imports, that a building so contrived should be advantageous, warm, pleasant, and useful, according to the intent designed, the person you build for, or use to which it is appropriated.

And first, with regard to its advantages: if for a house of pleasure, and a person of rank, divested of commercial connections, it should alway (if in town) be built in some open airy street, contiguous to some square, where there is a number of avenues and different streets that lead to public places, that no danger or demur may happen by the meeting of coaches. After a place is fixed upon, care should be taken in the design, that the exterior parts of the building have something more distinguishing than the common mode, both in form and execution, not inferior to the rank of the person you build for. The interior parts easy, connected, and suitable to their different purposes. The stairs contrived in a familiar place, and in the midst of the rooms above and below, that an easy entrance may be had to every apartment. The anti-chamber as convenient as possible to the stairs, that strangers may not be incommoded. The bed-chambers not too large nor too glaring with light. The back-stairs so contrived, that servants may pass to their own apartments and places of business without impediments from the best rooms; also that water-closets

ſets be placed in proper places without the leaſt annoyance; that ceſs-pools and drains be made of a ſufficient magnitude; that water may be had familiar to the kitchen, and every thing that can be obtained with reſpect to proſpect from the windows, &c. to render the whole pleaſant and uſeful, and in every reſpect adequate to the intent.

The ſame rules muſt be obſerved in every other building, whether it be for a merchant, trader, or manufacturor.—Firſt, the neceſſary appurtenances muſt be noticed; then what elſe of beauty may be thought conſiſtent with the deſign, muſt be added, with this main point in view, not to out-ſtretch the purſe and intent of your employer.

LECTURE XI.

Of Propriety *in* Building.

THE term Propriety is not ſo much as mentioned by *Andrew Palladio,* nor any author extant; all hitherto having contented themſelves that whatever was beautiful muſt be proper. This I deny; and want no greater vindication than a thorough examination into the preſent ludicurous mixtures of fragments, and which are all attributed as incomparable beauties, though in reality of ſpeech, they have not one property to recommend them.

I muſt confeſs, it is contrary to my plan or intent, to depreciate the deſigns of any ſurveyor, or private workman; but muſt point out the common errors of the age, leſt the young and unexperienced ſhould ſnatch the gorgeous bait, and imbibe ſuch a puerile ſyſtem of inconſiſtencies as may take them more time to eradicate than leiſure to acquire. — Notwithſtanding, there are many very elegant de-

ſigns

signs which border upon, or rather were the originals to the present shades of what is called Taste: but those abound in most of the merits which I define to be propriety, which is the exact bounds fixt for the finishing all sorts of work, and is the real substance of judicious experiments, which have been made by Altitudes and Geometrical calculations, to find the most approved proportions of unity that one member bears to another in an indivisible state; so that strength and beauty may be in circumscription of its power, and have a certain criterion or limit for their extension.

To attain a right understanding of this is one of the first principles that should attract the attention of every student or professor of building; for it is the only guide to perfection, and without which no proficiency can be arrived at. In many businesses and employs propriety is no more than the result of fancy, which hath a change or different effect upon almost every eye. But building is not subject to this mutable state; for when once a plan and elevation is given, and its intent and consequence known, the judicious workman of himself should proceed without the assistance of architect or surveyor. If he was well apprized and studied in the principles of building, every part and principle of a building may be reduced to a system, and hold such an affinity with nature, that harmony and arrangment may be seen through the whole, light and easy, and yet subject to the strict rules of Architecture.

This many of our men of modern notions will not believe, because they will allow nothing magnificent that is not composed of the present jargon of mutabilities.

I must confess I am far from considering the ancients

cients or their ſenſe of building in the leaſt compatable with the natural and ſplendid eaſe we ſee in many of our modern productions. The many ages of improvements, and different eſſays in every century, muſt have made ſome improvement, or their works and labours would have deſerved ſevere criticiſm. Though it cannot be affirmed, that the five orders of Architecture have received the leaſt addition for many ages, their compoſitions are ſo judicious, natural, and ſtriking, and bear ſuch a proportion with reaſon, that it has ſurpaſſed the abilities of every commentator, either to add or diminiſh, without eclipſing the beauty of the whole.

Many have attempted this great undertaking at this time, and daily leave laſting ſpectacles of their weakneſs and judgment. This is done with an intent (as they call it) to lighten the orders; the projection of their different members being by far too heavy for the ſplendid work of the times. But herein is their miſtake; for I will be bold to affirm in the preſent caſe, that whatever is taken from the projections adds weight to the whole in a double proportion. In order to prove this, I will only deſire my readers (if they are unacquainted with this great matter) to make two drawings of any of the five orders of Architecture; one according to the projections and dimenſions of *Scimozzi Palladio*, &c. and another with the projections of the preſent times, and you will find the laſt mentioned will be much the heavieſt: for it is a ſhrewd maxim in Architecture, that whatever is added to the head takes from the weight of the body. I have ſeen others, in order to take off the weight incurred by reducing the projections, add one diameter more to the ſhaft, and the like addition to the pedeſtal. But this was mending the matter with a witneſs; for then they

were

were under the ſame predicament with reſpect to the height of the mouldings; and in order to remedy one defect, plunged into numberleſs abſurdities.

The proportions of the orders are of ſuch ſenſible magnitudes that nothing artificial can ſurpaſs. I ſincerely wiſh, that every profeſſor of Architecture was convinced of this; for inſtead of gaudy, we ſhould ſee magnificent productions; and for arts and ſciences, we might juſtly vie with the world, and bid the greateſt nation defiance.

I do not mean by what I have advanced, that an Architect ſhould be confined to produce nothing but the works of the ancients. No: I muſt beg my reader to underſtand, that I have the greateſt veneration for taſte and improvement, and hold that to be the great ſupport of the individual: but I would not extend this beyond the rule of propriety; I would not, becauſe it is the faſhion to wear a club to my hair, ſtretch that beyond the bounds of reaſon, to the enormous ſize of my leg, nor, becauſe it is the taſte of the times, to make ſmall cornices and large frieſes to my rooms, to be in the very pink of the mode, make all frieſes and no cornice at all, which, to the diſgrace of beauty and propriety, is now almoſt the caſe. There is a medium or ſtriking effect in all the works of art, like the perfection of nature, which cannot be overtopped. But this is within the limits of beauty, which I ſhall mention hereafter: Therefore ſhall only propoſe a ſtandard for the propriety of walls, conſequence of light, ſize of chimnies, &c. and then give ſome obſervations on the beauties of building. — What proportions of unity the preſent taſte of building has or will bear with propriety, I ſhall mention in my criterion of practice ſeparately as they occur.

Of the Standard of Walls, &c.

And, firſt, of the ſize or thickneſs of walls, and depth of foundations, which chiefly depends on the height of the ſtructure, weight of the materials, &c. The depth of foundations by different authors allow one ſixth of the height of the building. But this I think unneceſſary; and inſtead of one ſixth, may be one eigth part of the intire height of the ſuperſtructure: the breadth of the foundation three fourths of its depth: the firſt ſtory two thirds of the foundation at the bottom, and from that diminſh one half brick every ſtory upwards. This I have found in the courſe of my own experience to be the beſt ſtandard that can be calculated; though this has exceptions in peculiar caſes, when the foundations are bad, and the conſequence of the building will not afford a ſufficient natural foundation to be made. In ſuch a caſe the ſize of the foundation may be augmented at the diſcretion of the builder. Obſerve, that the foundations diminiſh upwards, that regular ſet-offs be made on both ſides, ſo that a perpendicular line might be drawn through the foundation and middle of the wall at the top of the building, that ſolid may reſt upon ſolid.

There are many ſurveyors and builders who argue againſt regular ſet-offs on the outſide of a building, alledging, that they are only receptacles for water, which are oftentimes prejudicial to the ſtories below. But theſe are weak arguments, when compared to the ſtrength of the building, which muſt be defective when only ſet-offs are made on the inſide. The eaves and cornice prevent any water lodging upon the facios, &c. on the outſide,

side, except what happens by a lateral shower, which is very rare, and too trifling to be noticed.

I must confess, it has been the case in most of the new buildings about the town to make no set-offs on the outsides for some time; but here the builders greatly mistook their interest, (especially those who built for sale) because a house properly set off on both sides will not require to be so strong by one sixth of the quantity of materials, which would amount to a considerable sum in a large building.

The next thing of propriety is the height of stories, and their order, which should diminish in height upward, though in some particular cases it cannot, as when the magnificent rooms are appropriated to the second or third story: when it so happens, a thought must be had of the foundation, and something more added to the strength of the walls in the lower stories.

Of the Propriety of Chimnies.

In the construction of chimnies care should be taken to erect burrs in the foundation for the piers, lest the super-incumbent weight cause destructive settlements; that openings of chimnies be made porportional to the size of the rooms, and that funnels be made proportional to the openings: by this means there are hopes of being relieved from that great disturber of peace in a family, a smoaky chimney. This particular was quite unknown to the ancients; even *Palladio* only guessed at its properties. One would think that practical experiments should long ago have reduced this system to a certainty; but, alas! we are still in the dark, and may continue so, and leave it to be found out by the next century.

The

The beſt calculations that I can make for chimnies, and which in general I have proved to be anſwerable in almoſt every caſe, are by the following table nominated to the ſize of all the rooms that may occur in common practice.

My reader will obſerve that the following table is calculated from rooms ſuppoſed to be ſquare. When a room is otherwiſe, I bring it ſquare in the following manner: Add the length and breadth together, and take half for the ſquare of the room. For example: If a room is 14 feet by 10, I add them together, which make 24, look for 12 the ſquare of the room in the table, and you will find the height of the opening to be 3 feet 3 Inches, breadth 2 feet 6 inches, and depth 1 foot 5 inches, and ſo of all the reſt.

The method of finding the depth of chimnies is to add the height and breadth together, and take one fourth for the depth.

For example:

Suppoſing to the above dimenſions of 3 feet 3 inches by 2 feet 6 inches, I ſet them down as in the margin, which make 5 feet 9 inch. one fourth of which is 1 ft. 5 inch. the exact depth of the chimney.

Ft.		In.	
2	:	6	
3	:	3	
5	:	$9\frac{1}{2}$	
1	:	$10\frac{7}{8}$	the ſize.

The proportion of funnels is got from the depth of chimnies, and ſhould be always three-fourths of the chimney's depth for the ſquare of the ſide.

A Table

A Table of the Size of the Openings of Chimnies.

Square of Rooms.	Breadth of the Opening.		Height of the Opening.		Depth of the Chimney.	
	Ft.	In.	Ft.	In.	Ft.	In.
6	1	6	3	0	1	$1\frac{1}{2}$
9	2	0	3	$1\frac{1}{2}$	1	$3\frac{1}{4}$
12	2	6	3	3	1	5
15	3	0	3	$4\frac{1}{2}$	1	$7\frac{1}{8}$
18	3	6	3	6	1	9
21	4	0	3	$7\frac{1}{2}$	1	$10\frac{7}{8}$
24	4	6	3	9	2	$0\frac{3}{4}$
27	5	0	3	$10\frac{3}{8}$	2	$2\frac{5}{8}$
30	5	6	4	0	2	4

In order to ſupply the defect of ſtrength which every opening cauſes, diſcharging pieces of timber ſhould be laid acroſs the breaſt to take off the weight: in the end of the breaſt muſt be laid returning pieces, or what is called taſſels, which are of infinite ſervice. If the building is within the bills of mortality, and no taſſels or diſcharging pieces can be applied without incurring the danger of the penalty, arches of brick muſt be turned in the breaſt to anſwer the purpoſe.

Of Windows and their Opening.

The opening of windows hath been as little enquired into as the ſize of chimnies, although of material conſequence; for if a room be too glaring with light it is as defective as if it had too little: therefore a ſtandard of propriety ſhould be attained, in order to render this agreeable ſenſation as pleaſing

ing as possible. However an error committed in this particular may be more easily dispensed with, than the offensive evaporation of smoak. The following is a general rule.

Let the dimensions of a room be given, viz. Length, breadth, and height: Multiply the length and breadth together, and the product by the height, the square root of the last product is the quantity of light required. For example:

Suppose a room was 19 feet by 14 feet, and 12 feet high, I first multiply them as in the margin, the length by the breadth, and the product by the height, and extract the square-root of the last product, which gives 56 square feet, the real quantity of light required.

```
        19
        14
      ----
        76
       19
      ----
       266
        12
      ----
     | 3192 | 56
       25
      ----
106  | 692
       636
      ----
        56
```

The next thing is to dispose or appropriate the light into a number of windows. In the above case, for a room of 12 feet high a window should be about 8 feet. The 56 divided will make 28 feet each; for two windows which will answer the dimensions of 8 feet by 3 feet 6 inches, will be adequate to the intent. The same of any other dimension whatsoever.

LECTURE

LECTURE XII.

Of BEAUTY *in* BUILDING.

THE engaging enchantreſs Beauty is of a noble deſcent, her kindred are all famous in building, both in plans, elevations, and ſections. She is elder ſiſter of Taſte, begot of Elegance by Propriety. Such an extraordinary character ſhould produce ſtriking effects, which certainly is the caſe when her votaries purſue her ſteps with dexterity.

The peculiar graces which are attributed to Beauty, are freedom, eaſe, and perſpicuity, which in reality are ſo connected that no ſeparation can be obtained in their conjunctive copulatives.

If a man would arrive at a proficiency in this, he muſt firſt ſtudy the fore-mentioned qualities, viz. ſtrength, convenience, and propriety, before he can be a judge of this article: for it is certain a building may be ſtrong, convenient, and even abound with proper conſtructions and juſt dimenſions, and yet not poſſeſs one of theſe rare embelliſhments.

Some of my readers perhaps may be ſtaggered to know what I mean by Beauties; where they may be applied; of what they conſiſt, and how to be attained. Therefore it may not be amiſs to hint at its properties; though this analyſis would require the florid pen of the greateſt proficient of ſciences, yet they have hitherto paſſed it over as trivial, without that copious deſcription which the ſubject naturally requires. I muſt confeſs, I ſhould be extremely glad if my giving a few hints would animate ſome abler pen to elucidate this quality in its ſtriking colours: however, at preſent I ſee no reaſon why the

ſubject ſhould ſink to oblivion, becauſe people more capable than myſelf will not enter upon it.

The Beauties of building do not conſiſt in the profuſeneſs of ornaments, nor in the ſtrength of its different members, nor in the well-executed parts of the different artificers works in general; but in the perſpicuous compoſition and harmony which one thing with freedom bears to another, touched with ſuch an excellency of proportion that every thing may ſeem to have a natural or prime exiſtence of its own, ſuitable to the purpoſe, and in every reſpect adequate to the whole deſign; no latent or ſtudied maxims in peculiar faſhions that deviate from the delicacy of the arrangement, can be intitled to a place in the compoſition of Beauty; ſuch are crude and puerile notions, and Beauty is the dextrous reſult of ſound judgment, and cannot in any wiſe be attained but by propriety. Therefore in order to acquire a knowledge of this, the learner muſt firſt ſtudy the principles of building in general, its intent and ſituation, for what it is adapted, its appurtenances and relative conſequences; and endeavour to make the deſign anſwerable to the purpoſe, and the particular works anſwerable to the deſign; and let it conſiſt of ſuch well-choſen and lively embelliſhments as may add dignity and elegance to the edifice, and in no wiſe foreign either to the place or intent.

It is greatly to be lamented that we ſee architects capable of deſigning what they pleaſe, or of erecting any thing to any purpoſe, and yet neglect this powerful charm, not ſo much through a want of the knowledge of its peculiar graces, but through an idle notion of following the dictates of time-ſerving noveliſts: whereas if they would endeavour to follow the ſenſible dictates of their own reaſon,

I make

I make no doubt but we ſhould daily ſee more ſtriking proofs of their genius.

The fertile invention of an *Adams* can with propriety form what compoſitions he pleaſes: being in full poſſeſſion of taſte, he can make her dictates ſubſervient to his will; but I would caution inferior geniuſes, how thay ſtep forth in the dangerous path. Though there are (it muſt be allowed) very graceful attractions, and ſeemingly a very extenſive field to roam in; yet the leaſt impediment muſt of neceſſity diſconcert their ideas, and plunge them into ſuch a labyrinth of confuſion, that will require ſome difficulty to eſcape without inevitably deſtroying the point in queſtion.

LECTURE XIII.

Of ARCHITECTURE.

ARCHITECTURE is one of the nobleſt of the liberal ſciences, and bears its date ever ſince the time our firſt parents made an arbour to cover themſelves from the inclemency of the weather: its firſt principle is geometry, a moſt excellent knowledge, being the baſis and foundation of all architecture and building. The maxims of geometry are both ſpeculative and practical; from the firſt is demonſtrated the properties of lines and angles; the latter teaches how to apply them to practice in architecture, fortification, &c.

The word Architecture is now underſtood in a more improved ſenſe, and imports the conſtruction of an edifice either for private or public uſe, according to ſome or all the five eſtabliſhed ordes invented by the ancients, following their proportions, enrichments, and ornaments, every way ſuitable to

the bigneſs, ſtrength, and beauty of the work intended, and as they are laid down by the moſt celebrated artiſts, and all of them called from their places of invention, which are as follow, viz. Tuſcan, Doric, Ionic, Corinthian, a d Compoſite.

As there are not many noble treatiſes of architecture extant, I ſhall not take up much of my readers time with a theoretical definition of the five orders; nor can I, according to my preſent plan, allow it, my operation of practice being ſo extenſive: therefore ſhall only mention ſome few particulars relative to their riſe and conſequence, and proceed with my remarks of meaſuring, and other things of uſe for the aſſiſtance of thoſe to whom the plan is propoſed, which in general is the working part of mankind.

Of the Tuſcan Order.

The Tuſcan order had its original in *Tuſcana*, a remarkable place in *Italy*, from whence the name is derived. It is much the plaineſt of all the orders: notwithſtanding it hath great beauties if we conſider its uſe, and apply it where ſtrength is required. Its juſt proportions and well-deſigned form (where-ever it is well appropriated) are both ſtriking and elegant, though ſimple; yet its ſignificancy may juſtly vie with the richeſt. The column with its baſe and capitol ſhould be in length 7 diameters, the intablature 2. The Tuſcan column ſhould diminiſh one fourth of its diameter. The proper manner of placing this order, is at the bottom of a ſtructure; in which caſe it hath its real appearance, being of ſufficient ſtrength to ſupport the reſt of the orders above, or as many as may be thought conſiſtent.

Of

Of the Doric Order.

The Doric order took its riſe from the *Dorians*, a *Grecian* people which dwelt in *Aſia*. This order, though little inferior in ſtrength to the Tuſcan, is nevertheleſs frequently uſed without its pedeſtal, in places where little elſe but beauty is required. Though this order may be ſaid to have ſome deficiencies in ſome of its componant parts, yet upon the whole is a maſterly compoſition.

Many commentators have differed from *Palladio* in ſome particulars in this intablature; and if in any thing they have come near this great maſter, we may allow ſome of them a ſhadow of merit here.

The Doric intablature is a well-deſigned and noble piece of architecture; the ornaments and enrichment of bells and trigliphs, &c. in the frieſe and planceer of its cornice are ſo maſterly, that they are incapable of additions. Many in the execution of this order have, inſtead of the triglyphs, ſubſtituted flutes, &c. but to very little effect. If thoſe that took theſe liberties had but known the ineſtimable treaſure of beauties they had been rifling, they would have been content to follow the dictates of the greateſt judges that ever lived, rather than offend the eyes of every man of judgment and ſpeculation with their own paltry inadequate ſtuff.

This order may be applied to the firſt ſtory of a building, and is generally uſed ſo without the leaſt deficiency. Its column, baſe, and capitol may be made 8 diameters high, and diminiſh one ſixth of its diameter. This order is the beſt that can be made uſe of for the fronts of doors, &c. on account of its large projections, which anſwer every purpoſe in preventing the weather from affecting thoſe who have

have occcasion to wait at the doors of houses till time is gained for their admission; a thing which should be maturely considered, because the rain is usually more rapid and violent under the eaves of the edifice, merely owing to what is discharged from the cornice of the house set-offs, &c.

Of the Ionic Order.

The Ionic order, whose masterly composition and beautiful appearance was first invented in *Ionia*, a province in *Asia*. Of this beautiful order was built one of the seven wonders of the world, viz. the noble temple at *Ephesus*, dedicated to *Diana*, wherein there were made 127 columns, all of several intire stones of the Ionic order. The height of this column, base, and capitol is 9 diameters, and diminishes one sixth of the width.

The greatest beauty in this distinguishing order of architecture, is in the slenderness of the shaft of the column, and rendered more so by the flutings, which in this order hath a pleasing effect; also the volutes or rams-horns of the capitols are excellent additions as well as all its mouldings, enrichments, &c. which are little inferior to the Corinthian. This order is in its proper state when placed upon the Doric, and the Corinthian upon this.

Of the Corinthian Order.

The Corinthian order is the most noble and beautiful of all the orders, and took its original from the city of *Corinth*. This rich piece of architecture may justly be called perfect, beyond the power of art or genius to improve. Its merit does not lay only in the distinguishing order or arrangement of

any

any peculiar part, but in the harmony of the whole; being ſo well adapted, ſo proportionably juſt, that art and nature combined, muſt allow, in this grand compoſition, their meridian almoſt rivalled. One of the chief ornaments is the capitol of the column, whoſe height is equal to the diameter of the column below, and is compoſed of leaves to the number of 16; between which riſe ſmall ſtems or ſtalks, which form the volutes, and ſupport the abacus, which may be underſtood as the top moulding or covering of every capitol.

The Corinthian column with baſe and capitol ſhould be 10 diameters high; and when fluted muſt conſiſt of 24, and made half as deep as broad. The fillets or ſpaces between muſt be one third of the width of the flute: the bell or face under the leaves muſt ſtand perpendicular under the bottom of the flutes; in which caſe ſolid is under ſolid. The Corinthian pedeſtal is one fourth of the height of the column, and the intablature one fifth, which conſiſts of architrave, frieſe, and cornice.

Of the Compoſite Order.

This order had its riſe from the ancient *Romans*, who firſt invented it, and has its name merely becauſe it is a mixture, or compoſed of the Ionic and Corinthian orders, or rather of the whole five.

This order, by ſome, is reckoned the moſt regular and beautiful of the whole: but thoſe who are pleaſed to give it this appellation, do it either through want of judgment, or not inquiring into the merits of it, naturally attribute that beſt which is compoſed of all the beauties of the others. It is certain, that the parts of the Compoſite order are in a capitol light in their reſpective places; but as they

they now ſtand are rather puerile and unconnected, and may be ſtiled an immature compound of conſiſtencies, void of grace, and barren of invention. Why I ſay conſiſtencies, I would have my readers underſtand: The members which make this order are in their nature beautiful; but being applied or ſtretched beyond their real effect, they become ludicrous, wanting form and propriety. I cannot ſay that this order reflects any peculiar merit on the compoſers, though it is much better than any thing that we ſee invented in theſe days.

This order is uſually placed upon the Corinthian: but in that place it muſt appear to a diſadvantage, having no properties of its own to recommend it; and thoſe it doth conſiſt of are ſo feebly adapted, that it is the height of imprudence to place this order in any ſtate, unleſs quite abſtracted from the reſt; nor can it with the leaſt propriety be uſed on the outſide of a building. Its column with baſe and capitol is ten diameters, and ſhould not, if placed upon the Corinthian order, diminiſh more than one ſixth of the diameter below.

It would be well to conſider the nature of the orders in general, eſpecially with regard to the propriety of their ornaments, when appropriated to the outſide of a building. In my opinion, the chief elegance of a ſtructure is in its plainneſs, and would add much to the dignity of every building where the orders are introduced, if no ornaments were applied but where their want might be thought a viſible defect. For my own part I cannot think, that either carvings or fluting of columns have the leaſt ſhare of beauty on the exterior part of a building. Things of this ſort to me appear rather ſtudied maxims than natural effects.

I am very conſcious that ſome of the greateſt judges

judges of the age would quite contradict this opinion; but even grant it ſo, I am full as confident that thouſands will think otherwiſe. When they have leiſure to give this great particular a thought, and judge from appearances, I would only aſk any perſon of reaſonable abilities, whether the vaſt profuſion of ornaments laviſhed on ſome of the public buildings (which have lately made ſuch a noiſe in the world) be any addition to them? whether they are not more gaudy than grand, and loſe their natural magnificence by theſe ſuperfluous introductions?

I am ſorry that it ſhould be conſiſtent with my deſign to deſcant upon the works of ſo great an author; but the beſt ſhould have their faults pointed at, becauſe it is in the power of thoſe intirely to new mould the ſyſtem of buſineſs, and lead the unthinking world from the evidence of their own underſtanding.

LECTURE XIV.

Of MEASURING.

MEASURING is the art of finding the contents of ſuperficies and ſolids; and is that part of geometry, or rather practical mathematics, which elucidates ſome determinate quantity, appointed to be a ſtandard or common gauge for things to be denominated by; as to their length, breadth, and thickneſs: As a rod is a common meaſure for brick-work, a ſquare, yard, or foot, for defining the contents of carpenters, joiners, plaiſterers work, &c. which once underſtood, and where to be properly appropriated in the different artificers works, according to their nature and cuſtom, needs no

more than common Arithmetic to perform this mystery, which at this time is in ſuch eſtimation, and conſidered as a trade of the firſt conſequence; though there is little more in it than what any common ſchool-maſter is capable of; unleſs it is required a meaſurer ſhould ſtipulate the prices of the different works he runs over; in which caſe he muſt be well acquainted with the practice of the ſeveral works and branches of a building, as well as the quality and quantity of materials; a matter which many of our modern ſurveyors are totally ignorant of, and which reflects great indignity on their profeſſion: being one of the principal efforts to the ſcience of ſurveying, and of much more ſignificancy than fine drawings, which are too frequently the main object of gentlemen of this faculty. For if they are but tolerable adepts in this particular, they think but little of any thing more; for ſay they, with regard to prices and value of work, that we can eaſily acquire by getting the eſtimates of different workmen for the drawings we have to execute; out of which we can with little trouble fix different ones of our own. How little is a perſon of ſuch experience to be depended on, either with regard to the conſtruction, or the ſurveying of an edifice of conſequence? and yet to the mortal diſgrace of architecture, we have men that ſtile themſelves architects and ſurveyors who are hardly capable of building a warehouſe, without numerleſs errors; and at the ſame time if a workman of ſound judgment, adorned with the requiſites of taſte and long experience, was but to propound his opinion, though never ſo eſſential to the point, it would be at the hazard of his place, for but thinking to dictate to the genius of a man of ſpeculation, and, moreover, capable of making a drawing handſome enough for a print-ſhop.

It is greatly to be lamented that there is not a proper ſtandard or certain pitch of perfection in this as well as many other learned profeſſions, for a man to arrive at before he can be called either architect or ſurveyor, the one much inferior to the other, and thoſe who had not merit to the former be deemed the latter, and thoſe that had not pretentions ſufficient for either be termed meaſurers. A gentleman would then know whom he had to apply to for maſterly compoſitions and undertakings, there would be a viſible difference in their profeſſions though at preſent they are ſynonimous terms. I ſay, if there was ſuch a reſtriction upon the profeſſors of architecture, and none allowed the name but ſuch as had a thorough knowledge of the liberal ſciences, as well as a proper profundity of philoſophizing their effects, how few (in compariſon to the numbers that take the appellation) would be deemed capable of taking their degrees; notwithſtanding we have many fit to take the chair upon the occaſion, and likewiſe others to be cenſors.

But I beg my reader's pardon for this digreſſion, and will inſtantly proceed with my remarks upon meaſuring and taking dimenſions; a matter of ſome moment to every workman that may hope to be a maſter.

The principal thing in meaſuring (as I before obſerved) is the nature and cuſtom of it; that is, what is allowed as work to a ſtandard price allotted, what is work and half, double work, &c. Of theſe there is the greateſt variety in joiners work, which hath almoſt as many variations as different ſorts of work.

When a perſon is well apprized of the cuſtoms of the different inſtruments and modes of dimenſions, he muſt conſider the moſt advantageous way of ſetting his dimenſions down, ſo as to avoid con-

fusion and perplexity. In his book of dimensions he must be careful to separate with difference the various sorts and manners of execution with which the work is done, as well as the different apartments to which they belong, and every branch separate. But in order to give my reader as plain and concise a method as possible, it may not be amiss to give a sketch of a book of measurements, and all the common incidents that can occur in a building.

And first, of brick-work, which rule of measurement is by the rod of sixteen feet and an half square to one brick and half thick, which is the standard of all common brick work.

The usual way of measuring a building is to begin first at the foundation, from thence the first story, and so on to the top, taking every story separate, with their additions and deductions &c.

Example of Foundations.

Take the length of the front and one end, and double it for the length; and observe, if you take the length of the front from out to out, you must take the ends from the insides of the front and back walls, next take the height of the foundation, and write them down in the following order, to be squared at leisure.

Foundation.

Ft.	In.		
146	0	Length.	$\Big\}$ 4½ bricks.
6	6	Height.	

As

As all foundations should diminish upwards, in order to come at the real thickness of the wall, count the number of bricks at the top, the same at the bottom, and add them together, and take half for the thickness.

EXAMPLE.

If the foundation at the bottom be 5 ½ bricks thick, at the top 3 ½; those added together (as in the margin) make 9, the half of which is 4 ½, the real thickness of the wall, which is set down as above.

5	0 ½
3	0 ½
9	0
4	0 ½ bricks.

Next take all the party-walls, burrs for chimnies.

Foundations of party-walls.

Feet.

26 Length. }
6 Height. } 3 bricks—4 times.

The above dimensions are the supposed length and height of one party-wall 3 bricks thick; and for brevity I say 4 times, there being four cross foundations of the same dimensions. In the like manner take every thing within ground; then take the basement story, consider the set-offs both on the fronts and ends, and from the first length deduct or take the dimensions over again.

EXAMPLE.

EXAMPLE.

Baſement ſtory.

Feet.
145 Length.
10 Height. } 4 bricks.

Deductions of windows.

Ft. In.
9 5
3 4 } 4 bricks—6 times.

To add under windows.

Ft. In.
3 4
2 6 } 1 brick—6 times.

Deduct front door.

Ft. In.
7 0
3 11 } 4 bricks.

Deduct windows back front.

Ft. In.
8 10
3 4 } 4 bricks—3 times.

To add under windows as before.

Ft. In.
3 4
2 5

The firſt is the length and height of the baſement ſtory; next deduct the windows and doors in the front. In taking the deductions of windows, I think it the moſt familiar method to take the whole opening from the floor to the top, and after add the pieces under the ſaſh-frame, becauſe of the different thickneſs.—See the example.

Next take the breaſt of chimnies as they project into the rooms, which my reader will obſerve are all to be meaſured as ſolid, on account of the trouble, and pargetting the inſide. The method is to take the height to the turning of the trimmer, and the width of the breaſt, and after count the number of bricks it is in

in thickness; then deduct the opening.

Kitchen chimney to add.

Ft.	In.		
9	0	Height.	3 bricks.
6	6	Width.	

The opening of chimney to deduct.

Ft.	In.	
4	10	3 bricks.
4	6	

And in the same manner proceed with every deduction of inner rooms in every story, and the addition of chimnies, &c.

In taking the dimensions of vaults, first measure the butments to the springing of the arch, and after bend your rods round the arch for the width. The length of the place is undoubtedly the length. If the vault is groined, after you have measured the superficial content you must also measure the run or angles of the groin, which are always considered at least as superficial feet extra, and sometimes an additional price allowed, which will be stipulated in the practice of brick-work hereafter. There is one thing in the dimensions of end-walls to vaults that ought to be noticed, which is the rising of the crown of the arch; to which part the height of the end-walls must be taken. No allowance either for stuff or labour must be made for the want of the declivity of the arch, on account of the additional trouble of cutting and waste of bricks. The same thing must also be observed with respect to

to arches over doors; no deduction muſt be made for them, becauſe of the trouble. The dimenſions for the height of ſuch deductions muſt not be taken higher than the ſpringing of the arch.

As the meaſuring of chimnies in angles may be attended with, or ſeem a difficulty to thoſe unacquainted with the method; therefore I propoſe the following rule for practice.

Multiply half the breadth of the front or breaſt by the height, and that product by the number of half bricks contained in the half breaſt, (as to width) and divide the laſt product by 3, the content will be the content in feet; out of which the opening muſt be deducted, the ſame as in ſquare chimnies. See the example.

Suppoſe a chimney that ſtands in an angle to be 6 feet 6 inc. in breadth, the height of the ſtory 10 feet, I place them as in the margin, and multiply half the breaſt, which is 3 ft. 3 inches, and after multiply that product by the number of half bricks the half breaſt contains, which we may ſuppoſe to be 8; after I divide the laſt product by 3, the number of half bricks in the ſtandard of brick-meaſurement, which gives the above dimenſion 86 feet of reduced brick-work; after this you muſt deduct the opening, as in others chimnies. By the above example all other angle chimnies may be meaſured.

	Ft.	In.		
	10	0		
		3	3	
	2	6	0	
	30	0		
	32	6	0	
			8	
3 |	260	0	0 |	86
	24			
	20			
	18			
	2			

By

By the fore-mentioned method all ſorts of common brick-work is meaſured; in every ſtory the ſame, according to the thickneſs; re-bates, and deductions of the ſeveral walls, keeping every ſtory ſeparate till you come to the top of the edifice; the chimnies as ſolid all the way up; the parapet walls according to their thickneſs and dimenſions; the ſame of gable-ends and pedements. Theſe laſt mentioned articles may want ſome explanation with regard to the manner of meaſurement.

R U L E.

Multiply the length of the baſe by half the perpendicular, or the perpendicular by half the baſe, the product is the ſuperficial content. For inſtance: Suppoſe a gable-end, the baſe of which is 18 feet, the perpendicular or height 13 feet 6 inches, I ſet down 18 feet, the baſe, and multiply by 6 feet 9 inches, the half of the perpendicular, the product is 121 feet 6 inches, the ſuperficial content; then count the number of half bricks it contains in thickneſs, and proceed in every reſpect as in other work. I think it needleſs to ſay any more concerning the meaſurement of common brick-work.

Ft.	In.	
18	0	
	6	9
13	6	0
108	0	
121	6	0

The manner of reducing walls to the ſtandard thickneſs, I particularly mention in the practice of brick-work. The meaſuring gauged work, as arches, facios, cornices, &c. is as follows; and all valued by the foot ſuperficial.

The moſt familiar way of meaſuring a ſkew-backed arch, is to take the length of the top and bottom,

and add them together for the length, the height of the arch for the breadth. Circular arches must be measured as I have defined in my mensuration of circles, &c. Cornices of brick are measured as to length, and the mouldings girt with a string for the breadth. Facios are measured superficial.

In taking the dimensions of brick-work it is usual to take and give within the compass of an inch. For instance: If your length or width runs better than half an inch, you take the full inch; if under half an inch, nothing. For example:

If a wall was 74 feet 6 inches, and rather above half an inch more, you call it 74 feet 7 inches; and if rather less than the half inch, it would only have been allowed 74 feet 6 inches. In measuring of arches, &c. it is necessary to measure to the part of an inch.

The next work that is done by bricklayers is tiling, which is measured by the square of ten feet each way, which multiplied into itself contains 100 superficial feet. There is no difficulty in taking the dimension or of measuring tiling; only take the length of the roof between the gable-ends, and from the ridge to the eaves for the width; multiply the one into the other, and divide the product by 100, or cut off one or two figures to the left hand for squares. For example: If the number of feet contained be hundreds, cut off one figure for squares, the rest is feet. If the number of feet be thousands, then cut off two figures to the left for squares, (as in the margin.)

Suppose the side of a house contained 423 feet, then cut off the 4, which is 4 square; the remains 23 feet. The same of thousands of feet, as in the margin.

Square Ft
4,23
——
13,02
——

My

My reader muſt take notice, that deductions muſt be made for chimnies, and alſo in plain tiling. If there is a double courſe at the eaves, 4 inches more muſt be added to the width. With regard to hips and vallies, dormers or windows, where vally-tiles are uſed, the run of the angles, vallies, and hips muſt be taken: and for every foot in length a foot ſuperficial muſt be added to the meaſurement, on account of the trouble that attends them in practice.

If your roofs be hipped, take the length at the bottom of the ſides, and not meaſure the ends; for it is a maxim, that the two ends make out the want of the ſides.

The laſt of bricklayers work to meaſure, is paving; which is done by the yard, and which contains 9 ſuperficial feet. In this ſort of meaſurement there is no difficulty; only take the length and breadth of the place in feet, and multiply them together, and divide the product by 9, the quotient will be the content in yards, and the remains feet: afterward make the neceſſary deductions, and your work is compleat.

Of Carpenters Work to meaſure.

The works of Carpenters to be meaſured are the carcaſes of houſes, roofs, naked floors, partitions, centers, carriages to ſtairs, rafters feet, eaves, gutters, lintels, bond-timber, door-caſes, &c. which will be all treated of in the ſequel.

And, firſt, of the carcaſe of a framed building; the method of meaſuring which is to take the length of one ſide, and one end, and double it for the length, and that ſum multiplied by the height taken from the bottom of the cell to the upper-ſide

of the raiſing plate; the product will be the content in feet, which being divided by 100, or cut off as before obſerved, you will have the real number of ſquares the houſe contains, which is the rule of meaſurement for all timber-buildings, roofs, naked floors, &c.

EXAMPLE.

Suppoſe a houſe 50 feet long, 25 feet high, and 20 feet wide, how many ſquares are contained?

Firſt add 20, the width of one end, to 50, the length; that multiplied by 2, gives 140, the length; which being multiplied by 25, the height, the product is 3500 feet, which being cut off as before obſerved, the real content is 35 ſquares of framing. To a houſe of theſe dimenſions, note, in meaſuring the carcaſes of houſes no deductions muſt be made for windows, doors, &c. the extra labour to ſuch being more than adequate to the value of the openings.

$$\begin{array}{r} 50 \\ 20 \\ \hline 70 \\ 2 \\ \hline 140 \\ 25 \\ \hline 700 \\ 280 \\ \hline 35{,}00 \\ \hline \end{array}$$

Of Roofing to meaſure.

This ſort of work is alſo meaſured by the ſquare, the principles of which may be reduced to the following rule, whether true pitch, or the ends gable or not, viz. Multiply the building's length by the length of the rafter, and twice that product is the content in feet; then cut off as before obſerved, and the work is done. See the operation:

If

If the raftors are what is called true pitch, viz. three-fourths of the width of the building, then to the above building of 20 feet wide the raftors will be 15 feet, which being multiplied into 50, the length, the product is 750 feet; which being multiplied by 2, gives 1500 feet the content, which cut off as before, and you will find 15 square in the roof to the above dimensions.

```
  50
  15
 ----
 250
 50
 ----
 750
   2
 ----
15,00
 ----
```

To measure a gable-end in carpenters work is the same as in brick-work, viz. multiply the width by half the perpendicular, the product is the superficial content in feet. Note, the same rule will serve for measuring the hip-ends of roofs, only making the length of the raftor as the perpendicular.

Raftors feet and eaves boards are measured by the foot lineal, gutters and bearers per foot superficial.

Of Naked Floors to measure.

These are all measured by the square; the length and breadth are taken from the outside of the plates: if none are made use of, as in some countries, they are omitted, and lay the joists in the naked wall; in which case you must allow 9 inches, or else measure the full extent of the joists, and from thence compute the squares contained by the above examples; the same of ceiling-joists, partitions, battening the walls, &c. allowing the deductions of doors, windows, &c. if they are agreed upon, else not.

Of

Of Centers to meaſure.

Centers are meaſured by the ſquare; the dimenſions are taken from the ſweep of the arch, and the length of the place.

Small centers to doors and apertures, &c. are meaſured by the foot ſuperficial.

Carriages to ſtairs are meaſured by the foot ſuperficial; the leading pieces or ſtrings by the foot ſolid; truſſing of girdles by the foot lineal; door caſes of timber by the foot cube; lintels, bond timber, diſcharging-pieces, &c. are all per foot cube; weather boarding per ſquare; trunks per foot. All the prices and real value are ſtipulated in the practice of carpenters work.

Of Joiners Work to meaſure.

The meaſurement of joiners work is attended with more difficulty than all the artificers work beſides, merely owing to its extention, or great variety of practice, and the leaſt underſtood of any, chiefly through a want of attention, or judicious enquiries into the length or conſequence of time which every piece of work takes in the execution. Could this be once aſcertained, the whole might as eaſily be reduced to a ſyſtem as any other work.

In defining the real principles and properties of this branch of buſineſs, I ſhall be as particular as the ſubject may require, both with reſpect to time and mode of meaſurement, in order to render the deſign as facile and uſeful as poſſible both to profeſſors of building, and others that may be deſirous of making themſelves fully acquainted with the practical requiſites, as well as the mode of meaſuring a building.

The

The work done by joiners in a building may be reckoned or defined, in the following ſhort terms, to be every thing that is worked with a plain; therefore will need no farther explanation than what may be aſſigned in the different works as they occur. And firſt, of frontiſpieces.

Of Frontiſpieces to meaſure.

Frontiſpieces are meaſured and valued by the foot ſuperficial, and every part thereof meaſured ſeparately, and all bear a different price. But the beſt way of giving the learner an idea of this piece of workmanſhip will be to ſet down the different meaſurements by ſuppoſition, as before obſerved of brick-work.

Of the Grounds and Jambes.

	Ft.	In.		
	7	0	Length	twice.
By	1	4	Width	

Grounds from the top of door to the top of pediment.

Ft.	In.	
5	8	Width.
4	0	Height.

Columns with baſe and cap.

Ft.	In.		
7	3	Length	twice.
1	9	Girt	

Firſt take the dimenſions of the grounds at twice; firſt to the height of the door, for the two jambs, and from thence to the top of the pedement, which muſt be taken to the extent of the height and width, making no deductions for the fan-light, nor what is cut off at the top, to form the pedement, on account of the trouble and labour

bour that attend them. First I take the supposed length and width of one front, stile, or jamb, and set it down as observed next the ground, above or under the pedement; then I take the columns, the shaft, and base, and cap for the length, and the girt round the column for the width; the supplinth length and breadth; the trunks that stand perpendicular above the shaft of the column, for the architrave, friese, and cornice, to rest upon the next architrave. Level cornice; the scima recta that mitres to the raking-mould of the pedement; length of cornice on both sides of the pedement; level blocks or mutules, raking ditto; impost; jamb-linings, bead, and flush; circular sopheat ditto, and door-case; measured cubical. The ovlo double ble

Subplinth.

Ft.	In.		
2	9	Length	twice.
	4	Breadth	

Trunks or grounds for the architrave, friese, &c.

Ft.	In.		
1	6	Length	twice.
2	2	Girt	

Architrave.

Ft.	In.		
2	6	Length	twice.
	6½	Breadth	

Level cornice to the top of the facio.

Ft.	In.		
3	0	Length	twice.
	10	Girt	

Scima Recta level that mitres to the pedement.

Ft.	In.	
1	3	Length
	2½	Girt

Length of Cornice on both sides of the pedement.

Ft.	In.	
5	9	Length
1	2	Girt

Mutules, or Blocks level.

6

ble measure. Fan-light, when measured by the foot, you must take the width of the door and the height of the crown. Observe also in girting the impost, that you take from the grounds, and extend the line all round the face of the moulding, and likewise the same with respect to the ovlo.

Though the above dimensions are contingently set down, without propriety to their respective proportions, yet the manner will serve to instruct the learner the same: after the measurements are thus taken, the mode of squaring them is familiar; the different prices to all the dimensions will be considered in the practice of frontispieces.

Ditto raking.

5

Impost round the Jamb-linings.

Ft.	In.	
8	0	Length
	6	Girt

Jamb-linings, bead, and flush.

Ft.	In.		
7	0	Length	twice.
1	8	Breadth	

Circular sopheat, bead, and flush.

Ft.	In.		
5	0	Length	Double measure.
1	8	Breadth	

Door-case.

Ft.	In.		
7	4	Length	Scantling 4 by 3.
4	0	Width	

Ovlo round the circular head.

Ft.	In.		
5	0	Length	Double measure.
	$2\frac{1}{2}$	Girt	

Fan-light.

Ft.	In.	
3	6	Width
1	9	Height

Door bead and flush.

Ft.	In.
7	0
3	6

Cover boards and bearers.

Ft.	In.	
6	0	Length
1	6	Breadth.

Of Floors to measure.

Floors are measured by the square; the dimensions are the full extent of the rooms both ways. Observe in measuring floors, that you make no deduction for the slab at the fire-place: the reason is, the putting round the border is always considered as equal to that part of the floor being laid out. What part of the floors is laid into the windows, closets, &c. must be added.

Of Dado to measure.

Dado is measured by the yard; the dimensions are thus taken, viz. For the breadth, take from the floor to the under-side of the capping; the length is the round of the room, allowing an inch more at every angle; the length and breadth being multiplied together, give the content in feet; after divide the product by 9, the quotient is the number of yards. Observe to deduct chimnies and doors.

The reason the dimensions are thus taken for the the width of Dado, is, it is customary to consider the skirting at the same price; and as the Dado, does or

or ſhould go as low as the top of the ſkirting, there can be no error in ſuch mode of meaſurement. When dado and ſkirting are of different prices they muſt be meaſured ſeparate.

Of Mouldings to meaſure.

Mouldings are all meaſured lineal or ſuperficial by the foot: when the former, you have nothing more to do than take the length; when the latter, you muſt girt all the face of mouldings with a ſtring for the breadth, and the round of the room for the length: after deduct doors and chimnies.

Sur-baſe mouldings are always girt over the face and round the capping; the baſe moulding is girted as much as ſeen, and half an inch more allowed than is ſeen for the re-bate that ſtops the ſkirting.

Architraves are taken with a ſtring over the top and down both jambs for the length, and girted round the face and back to the wall for the breadth.

Cornices per foot ſuperficial, and are girt as much as is ſeen for their breadth: the round of the room for the length; and ſo of all mouldings worked by hand. All houſe plain mouldings are per foot lineal.

Wainſcotting is meaſured by the yard; the height of the room for the breadth, and the girt or round of the room for the length. Obſerve in this to deduct doors and windows.

Torus ſkirting is meaſured by the foot ſuperficial; the breadth is got by a ſtring girting the moulding to the floor; the round or extent of the place for the length. Obſerve, that this ſort of ſkirting to ſtairs is always allowed double meaſure; the ſame of raking, dado mouldings, &c. if they are ramped, as the hand-rail of the ſtairs.

Of Doors to meaſure.

Doors have different rules of meaſurement; ſome by the foot, others by the yard. All framed doors are meaſured by the foot; batten and ledged doors by the yard. If they are what is called double doors, that is, framed and moulded on both ſides, they are accounted as ſingle meaſure, and a price ſtipulated accordingly. The dimenſions are the neat height and width.

Doors that are only moulded on one ſide, are called meaſure and half; batten and ledged doors ſingle meaſure. All ſquare framed doors are ſingle meaſure.

Of Columns to meaſure.

Columns of the Ionic, Corinthian, or Compoſite orders are all taken ſeparately from their baſes and caps; firſt, the ſhaft, then the baſe and the caps likewiſe, being all of different prices. If the column or pilaſters are fluted, you muſt girt round the flutes. They are all valued by the foot ſuperficial.

Door-caſes and jamb-linings are meaſured and valued by the foot ſuperficial. The length of the two jambs and the width of the opening is the length. The width of the lining girt down the rabbit for the breadth, ſingle meaſure like wainſcot.

Of Window-Shutters to meaſure.

Window-ſhutters and back-linings are all meaſured by the foot; the front ſhutters as meaſure and half. If they are only framed on one ſide, the back-flaps

back-flaps and back-linings single measure, whether framed, flush, or square.

Backs and elbows and sopheats are by the foot single measure.

Grounds to windows per foot superficial.

All other grounds in general per foot run.

Sashes and Frames to measure.

Sashes are measured and valued by the foot superficial. The dimensions are thus taken: the two heights of sashes are added for the length; the width of the frame for the breadth. Sometimes the sashes and frames are valued together; when so the exterior parts of the sash-frame are the bounds of dimensions. Sometimes sash-frames are done per piece. All circular headed sashes are only allowed double measure. In some counties they have a method of girting all the bars of sashes both ways; but this is obsolete, and ought to be abolished every where.

Of Chimney-pieces to measure.

Chimney-pieces of wood are measured by the foot superficial and lineal, according as they are finished. First the grounds are per foot superficial. If the chimney-piece has no ornaments about it, the architrave, friese, and cornice may be taken as other mouldings, in the manner of the former observations on frontispieces. If there are terms at the sides and ornaments, these must be valued separately. So likewise of ornaments in the friese, flutings, frets, &c. in the cornice; and are per foot run, and a price according to their value.

Of

Of Stairs to meaſure.

Stairs are meaſured and valued by the foot: the dimenſions taken by a line bended or girted down; the riſer and tread over the noſings, from top to bottom for the length: the breadth is the width or length of the ſtep. Common ſtairs are ſometimes done at ſo much per ſtory.

Hand-rails to ſtairs are ſometimes meaſured by the foot ſuperficial, ſometimes the foot lineal. When the former, the rail is girted round for the breadth, and the ſtreight part of the rail for the length. With reſpect to ramps, twiſts, ſcrolls, &c. they muſt be taken ſeparate, becauſe they are always double meaſure. The baniſters and newels at per piece; the ſtrings per foot ſuperficial, girted as other architraves; brackets at per piece.

Sometimes hand-rails to ſtairs are valued with the brackets, ſtrings, and baniſters, at per foot ſuperficial, and the dimenſions taken in the following manner: For the breadth take a ſtring, and girt from the top or middle of the rail down the baniſters, and over the ſtring for the width; the length of the rail from top to bottom is the length. But for the particulars of ſtairs in every reſpect, you muſt turn to the practice of them.

My reader muſt obſerve, in taking the different dimenſions, to be particularly careful in his book, to keep every work ſeparate.

The beſt method of meaſuring joiners work through a whole houſe, is to keep a length or leaf for all ſorts of work of one price, and only make obſervations on the different ſtories.

Suppoſe

Suppose the following to be a sketch of leaves.

Dado ground-floor.

Ft.	In.		
48	6	L.	East parlor
2	5	B.	
36	4	L.	W. parlor
2	5	B.	
30	3	L.	Hall
2	5	B.	
36	7	L.	Study
2	5	B.	

Mouldings to ditto. Base and impost.

48	6	L.	East-front parlor
	3	B.	
Sur-base.			
48	6	L.	
	5	B.	
39	4	B.	West parlor
	3	L.	
39	4	L.	
	5	B.	
30	3	Base	Hall.
	3		
30	3	Sur-base	
	5		
36	7	Base	in Study.
o	3		
36	7	Sur-base	
o	5		

Architraves to ditto. Architraves to Windows.

18	o	twice	East Parlor.
o	8		
Ditto of Doors			
17	3	twice	
o	8		
Windows.			West parlor
18	o	twice	
o	8		
Ditto Doors.			
17	3	twice	
	8		
Window			Study.
18	o		
	8		
Door			
17	3		
	8		

In the above manner it will be requisite to place the dimensions, so as to avoid perplexity, keeping other leaves for floors, window-shutters, &c. and every floor separate; by which means you will avoid an infinite trouble when you come to square the dimensions.

Of

Of Plaisterers Work to measure.

Plaisterers work hath in the manner of measurment (in some particulars) as much variety as joiners work, especially in ornament ceilings, which require great understanding, as well as an extensive practice, to come at a just criterion for the different enrichments, which are all taken and valued by the foot lineal and superficial. Sometimes they are done at a fixed price per ceiling; but a man must have great experience to guess at a matter of such consequence by the bare inspection of a drawing; although it is certain a man cannot do otherwise than guess at the value of some particulars, as figures, deities, trophies, &c. which ever vary with the subject. However, the first thing to be taken is the plain of the ceiling, which is by the yard; next the cornice, friese, with enrichments, &c. which must be girted as joiners work; the round of the room is the length.

Having done this, proceed to take the ornaments upon the ceiling, in the following order; first, take all the mouldings lineal, whether carved or plain. If the mouldings are any of them cast, they must be noticed: If any of the mouldings are oval, circular &c. they must be considered as measure and half. Then take all the sweeps of foliage as superficial. In the following manner take the length and width of the square in which the ornaments are contained, and, according to their value, stipulate the price, as you go on, to every sort of work. To avoid perplexity, if there are any golicchi, frets, above three inches wide, they must be taken superficial, otherwise lineal. Ribbans over mouldings are run trophies, and all large conjuctions, per foot superficial:

ficial: figures are uſually valued at per piece; all enriched frieſes, feſtoons, &c. per foot ſuperficial; if frieſes are caſt, they are valued in the cornice; belexion mouldings are per foot lineal; large pannels of ſtucco per foot; all walls and plain ceilings per yard: all circular work meaſure and half; Ionic, Corinthian, and Compoſite caps per foot ſuperficial. Obſerve in meaſuring walls to make deductions for windows and chimnies.

Of Glaziers Work to meaſure.

Glaziers works are meaſured by the foot; the dimenſions are taken in feet, inches, and parts of a foot: therefore it is requiſite that glaziers ſhould underſtand decimals; though, for my own part, I ſhould propoſe duodecimals, being quite as correct, and much more familiar and conciſe to learners.

The two following examples will prove what has been advanced on this particular; the one by decimals, the other by duodecimals: and although they both anſwer the intent, I think to learners the duodecimals ought to have the preference.

Suppoſe a piece of glaſs leaded was to be 3 feet 6 inches by 1 foot 6 inches:

By decimals.	By duodecimals.
Ft. In.	Ft. In.
3,50	3 6
1,50	1 6
17500	1 9 0
350	3 6
5,2500	5 3

By the former method (by decimals) it appears that the light of glaſs is 5 feet and 25 parts, equal to one-fourth of a foot; and by duodecimals 5 feet 3 inches, which is one quarter of a foot. My reader will obſerve, that in meaſuring ſaſh-windows there is no occaſion to take dimenſions of more than one ſquare; and that multiplied by the number of ſquares in a window, will give the content; which once got, requires no more than to add or multiply by the number of windows in the ſtory, or of one ſize, and that ſufficiently reſolves the queſtion.

In ſome counties the glaziers only meaſure the exterior part of the glaſs for length and breadth, allowing nothing for the thickneſs of the bars: but this is an exorbitant way, and ought to be eradicated.

Of Painters Work to meaſure.

Painters work is meaſured by the ſame rules as joiners, with this difference only, that they do or ſhould meaſure all edges where the bruſh goes. But ſurveyors are not always ſo particular, and frequently allow no more meaſure to painters than joiners, except in caſe of doors, window-ſhutters, &c. which with painters are always double meaſure, the ſame as any thing elſe that is painted on both ſides: all wainſcot, dado, moulding, doors, ſhutters, jamb-linings, architraves, &c. are meaſured by the yard; cornices of all ſorts and ſingle ſkirting by the foot run; frontiſpieces, &c. by the foot; ſaſhes, ſaſh-frames, caſements, window-lights, &c. are done per piece.

Of

Of Maſons Work to meaſure.

Maſons work is all meaſured by the foot, though with a difference, as cubical, ſuperficial, and lineal. Firſt, with reſpect to the cubical method, which is uſed for all blocks of ſtone, marble, &c. and which is in the manner of work always conſidered as ſuch, when the thickneſs of the ſtones exceed 2 inches; all under this ſtandard are meaſured as ſuperficial. When ſtones are or exceed the ſolid ſtandard of 2 inches, they are firſt meaſured ſolid, and after ſuperficial, for the workmanſhip, with this reſtriction, that no more of the ſtone be meaſured than what appears without the wall; the ſame of all columns, pilaſters, cornices, facios, ruſtics, &c. The ſuperficial meaſure concerns all the pavings, floors, hearths, ſlabs, mantles, jambs, covings, &c. and the general dimenſions of all labour; the run or lineal foot is uſed for all ſmall abſtracted mouldings, ſome carvings, frets, ornaments, &c. Obſerve, that maſons girt all their moulding as the joiners do, and take their dimenſions in feet, inches, and parts. The greateſt difficulty in meaſuring maſons work is in chimney-pieces, on account of the various modes and prices, and number of different dimenſions. But ſee the following example:

Firſt, take the dimenſions of the ſlab; then the mantle, or head-ſtone, being both of one length; add the two widths together, allowing an inch for the under-edge of the mantle more to the breadth. Secondly, take the length of the jambs, allowing an inch more to the length than is ſeen, for what goes behind the ſlab. If there are noſings and ſlips to the jambs, take the length as obſerved, and girt all that is ſeen for the width: next take the fire-

ſtone-hearths, covings, &c. and meaſure all that appears in ſight. If the frieſe, cornice, and ovlo are marble, they muſt be girted as the joiners do their work: the ſame of ornaments, frets, terms, flutings, &c. and all valued accordingly.

Of Carvers Work to meaſure.

Carvers work is all meaſured by the foot ſuperficial and lineal: by the former all capitols to columns, large ornaments, feſtoons, foliage, flutings, frets, &c. the latter is uſed for all ſmall mouldings, ribbons, huſks, &c. and the dimenſions taken in the ſame manner as obſerved in plaiſter ceilings.

Of Slaters Work to meaſure.

Slaters meaſure their work by the ſquare, the ſame as tiling, both with reſpect to hips, vallies, double eaves courſes, &c. therefore needs no farther comment than what has been already advanced.

Having finiſhed my diſſertations and ſtrictures on mechanic powers, the principles and properties of building in general, the five orders of architecture, meaſuring the different artificers works, &c. I ſhall now proceed, and relate what is neceſſary to be obſerved in the practice of different works as they occur in time and place. But before I begin, it will be proper to ſettle my criterion touching the univerſality both of the prices and eſtimations of the

the ſeveral works in a building, as well in the very remote parts of the kingdom, as thoſe more contiguous to the capital, which I very familiarly ſettle upon one general ſtandard.

Though the manner of fixing and ſtating a matter of ſuch conſequence, and ſeeming ſo full of exceptions, may appear an impoſſibility to ſome who have not enquired rationally into its principles; yet I hope to evince to every workman of experience, that one ſchedule of prices with reſpect to labour will ſerve, or at leaſt ought to ſerve for every city and principal town in the kingdom. I muſt own, there may be various objections alledged againſt this univerſal ſyſtem, yet not one argument ſufficient to turn the mode of the following plan.

LECTURE XV.

A new Plan for ſettling the Prices of Work done in a Building, all upon one Footing, both in London *and every capital Town in the Kingdom.*

WHoſoever my reader is, whether architect, ſurveyor, maſter, or common journeyman, that may ſmile at an attempt ſo extravagant, I humbly beg for a moment a ſuſpenſion of his riſible faculties, till he maturely weighs this matter; after which, I am fully perſuaded, he will find fewer objections of its feaſibility than he firſt imagined. If I conſider it right, this great point has but two queries to be determined, which once anſwered will totally deſtroy every objection. The firſt is, whether a maſter in the country (if his work is executed as well) ſhould bear a leſs price than the ſame work

work done by a *London* maſter in town? The ſecond is, whether a journeyman in the ſame caſe ſhould receive the ſame wages of a country-maſter as are paid to journeymen in town? To the former of theſe queſtions I anſwer, yes; to the latter, no; and will endeavour to prove it. But before I give my own deciſion to this affair, I beg to introduce the opinion of a perſon of ſome abilities in one of the capital profeſſions in a building relative to this univerſal ſcheme. " My friend," ſays he, " this plan of allowing as great prices to country-maſters as thoſe in *London* will never anſwer, becauſe they are not liable to half the expences, nor does their work coſt them half the ſum in point of labour, on account of the ſcanty wages which are given in the country, all over the kingdom; therefore ſhould have a price ſtipulated by a country-ſurveyor, according as the work may deſerve." Something of this kind I know runs in the notions of moſt people that think upon it.

That maſters in the country are not liable to ſuch expences as maſters in town, I will readily grant, both with reſpect to yards, houſe-rent, and ſtowage for their different materials; nor has a country-maſter in general half the buſineſs of a *London* one; and what is ſtill more to his diſadvantage, he is not required to finiſh his work with half the expedition. It is therefore upon this topic we ſhould bend our thoughts: If a maſter in *London* can employ the year round 15 or 20 men, which may be called the medium, (being as many above as under this number) and a maſter in the country employs but 7 or 8, and both have their work at one price, we ſhall find that the *London* maſter will have it in his power to live conſiderably better, notwithſtanding the difference

difference of expences, as well as the advantage of wages, which ſome think to be very great.

Every man of buſineſs, whether in town or country, ſhould be ſupported by his buſineſs, and reap ſuch an allowance or emolument by his profeſſion as may enable him to guard againſt the contingencies of a family, and in ſome ſort equal to his induſtry. If it was poſſible for a country maſter to have as many jobbs as the maſters in *London* uſually poſſeſs, and all required to be forwarded with the ſame expedition, their prices ſhould be conſiderably lowered: but as that is a chance which never can happen, the reaſons are obvious, that in this firſt reſpect no difference can be made without a viſible injury, as will palpably appear upon enquiring into the difference of wages.

Secondly, that men in the country ſhould not have the ſame wages as journeymen in town, is evident from their want of experience both in the methods and inſtructions of work. My reader, I hope, does not ſuppoſe that I would propoſe country wages to a man of the firſt merit in his profeſſion; No. A man thus qualified, that hath had ſeven or eight years practice in *London* amongſt the moſt capital of his branch, and has not imbibed any but judicious methods of working, and been in the full practice of ſuch for ſome time, will be worth as much wages to a country maſter as a town one, and in reality more; eſpecially if he is impowered to forward his maſter's buſineſs by his own advantageous methods.

Notwithſtanding there are many good workmen in the country that have never ſeen *London*, yet thoſe compared to men of the above experience will in every point of practice be more deficient in the courſe of a week's work than the difference of wages, ſuppoſing

ſuppoſing the one to have 4s. or 5s. per week more wages.—I ſpeak not this from ſpeculation, but undeniable facts; having myſelf been and examined into the nature of practice in almoſt every town in the kingdom, and have ever found, that if the maſters were allowed the ſame prices with the maſters in *London*, notwithſtanding the difference of men's wages, with the ſame number of men a *London* maſter would have had the above advantage in point of profits; only with this obſervation, that the men from *London* muſt be good, and ſuch as have had the above advantages. It is true, that there are hundreds of men in *London* ſo bad, that one would think it almoſt impoſſible to fellow them, or even ſuppoſe that they could have ſerved a proper time to any buſineſs; and how to account for this otherwiſe than from a want of attention to their real intereſt, or proper good, would almoſt puzzle the greateſt philoſopher. For it is certain, that all trades and employs are ſo familiarized, and have at their heads ſuch noble inſtructors, that with cloſe application even the weakeſt capacity may be poſſeſſed of ſuch points in practice as will enable him to deſerve the common wages. Thoſe that arrive at a greater pitch of merit ſhould be rewarded according to their induſtry.

There is one thing which ought to be mentioned to country journeymen, that is, the little reſpect they pay to compariſons and arguments touching men of *London* experience; for, ſay they, we have worked with men from *London* at ſuch and ſuch gentlemen's houſes, but could not find any material difference between them and us that had never been there. This I believe to be often the caſe, and which reflects great weakneſs in the *London* maſters, for ſending to any country jobb, men that were not really

really proficients in their branch; for when masters want a number of men to go into the country they seldom enquire more into their characters than their stability. Being carpenters, if they have got a chest of tools, away they are are sent to finish something in a peculiar manner to what could in any wise be done by country-men, when perhaps some of these very men had not been six months in town.

It ought to be a fixed rule in masters never to employ a man for a country jobb that was not approved an excellent workman; and moreover, he should be of a remote county or shire to that the work is done in, to subvert the proverb of a prophet in his own country having no honour. I hope from those hints, that no reasonable man will start an argument against the questions before stated, but freely allow a right for country-masters to have the same prices as masters in town. I do not mean such as are exacted by some masters, but such as may be considered as just ones.

I believe, upon a thorough review of the wages both in town and country, we should not (upon the whole) find much difference. In some respects the country-masters have the advantage, especially in some parts of carpenters work, as roofing, stairs, sashes, floors, and in many other branches of a building, and most of those things they get considerably less by, through a want of experience in the journeymen (notwithstanding their low wages) than the masters do in *London*; not but there is room enough in both places for the journeymen's wages to be raised; and if this scheme is not shortly put in execution, I am persuaded the consequences will be very alarming to all masters in the building branch.

It was a piece of the weakest policy in the master-

carpenters the laſt time the journeymen ſtruck (for an advancement in wages, ten years ago) that they did not comply with their eaſy demands; they would not then have had occaſion to fear the preſent mode of architects engroſſing the whole buſineſs into their own hands, which ſeems to be the general plan, if ſome ſtop is not immediately taken to prevent it; and none ſeems ſo promiſing as advancing the journeymens wages. The capital architects and ſurveyors that have adopted the plan of finding all materials, and only allowing even principal maſters a ſort of prices like taſk-maſters for executing the work, do this through a knowledge of the exorbitant advantages that ariſe from work at the original cuſtomary prices; and as this method is put in practice by the firſt men in the kingdom, the inferior ſurveyors, in order to be in the faſhion, will ſoon follow their example; not that I mean to infer, that cuſtomary prices are exorbitant. If journeymens wages were ſettled in proportion, the preſent luxury of the times will not admit of abatements in any profeſſion. My reader muſt obſerve, ſince prices were ſettled for all works in the building branch, (though they every year vary in ſome particulars) that every buſineſs is improved in point of practice above one third; nay, in ſeveral points and parts, the work is done for one half the expence to maſters that it coſt them 20 years ago, and all through the aſſiduity and ſtudy of the journeymen, notwithſtanding the maſters will not give any more wages; which ſets them upon an exact parr with the ſurveyors in point of diſpoſition; each ſtriving to engroſs the whole. The latter not content with the great allowance of five per cent. for the works they ſurvey, but want to double it by the advantage of finding materials;

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and as they have it in their power to colour their proceedings to the gentlemen with a view of parsimony, there is no doubt of their carrying their points in every respect; which will only pay the masters in their own coin, for their avaricious dispositions, in condemning to a life of slavery and indigence men of abilities, by whom they have their chief support. For considering the exorbitant price of provisions, and every other incident to life, no man that has any family can of 16s. per week more than exist; nor a single man ever get a coat to his back, unless (if I may be allowed the phrase) he spares it out of his belly: therefore what better than slavery can we call it? and yet at the same time the masters enjoy a profit (which results chiefly from the mens labour) equal to the fortunes of some of our nobility. Though this may seem strange to some, I have had undeniable facts of many masters in the building branches, whose business is worth 2000 l. per annum, at this time. Therefore, I will appeal to every feeling heart, whether this ought not to be a matter of great consideration, and not beneath the thought of the legislature.

If I was not or might be thought too particular, I would state the case of a carpenter, and leave the world to judge of the severity of his situation; and how unthinking a father must he be, who proposes any emolument for a son who is apprenticed to this ingenious, and well worthy the name of liberal art, if he has not almost as much to put him in possession of, as will be a support without business?

Every man, in the country in particular, from whence most of the journeymen in town generally have their origin, in the raising of a family suits his childrens occupations according to their strength or genius; though, at the same time, he with fa-

vourable incitements makes his will a ſort of choice of their own. Him that ſeems athletic and ſenſible, or quick at learning ſchool-exerciſes, he propoſes for a carpenter, and ſays, if he turns out well, he'll no doubt make his fortune.—Yes, adds the fond father, I make not the leaſt doubt but he will have as much buſineſs as Mr. Whole-deal, our neighbour, and cut as great a figure in the world: —and all this without the laſt caſualty; no conſideration of the improbability of his getting to be a maſter at all, without doubt of intereſt and large connections; if he does but get to be what is uſually called a good hand in his buſineſs.

Well:—We will ſay he is bound an apprentice, for which his father gives 20 l. finds him all his cloaths, and perhaps waſhing; and ſome fathers are obliged to find their ſons tools during their ſervitude. But this we will omit; and take the expence of his apprenticeſhip, cloaths, ſpending-money, and the 20 l. he gives to be inſtructed in his buſineſs, at almoſt 100 l.—and when he is out of his time, through the little practice allotted to apprentices, and the many requiſites to be attained before he can have any idea of this extenſive branch, (ſave a little uſe of his tools,) he is almoſt as much to ſeek as when he firſt went apprentice; only with this obſervation, that he has learnt ſo much as gives him an underſtanding to know that he muſt learn ten times more before he is fit to be a maſter. Then he commences journeyman, with a view of getting his buſineſs, and works for a year or two in the country; ſtill he finds himſelf far ſhort of what he wants, and nothing then will ſerve but coming to *London;* for there, ſays he, I ſhall have practice enough, and ſee through my buſineſs three or four times a year. When he gets to

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London, the great object is a cheſt of tools, which he either muſt be poſſeſſed of, or cannot be forwarded in the leaſt in his buſineſs. — If his father is in circumſtances, application is made, and ten guineas remitted to get him the neceſſary implements; after he has got theſe, he naturally makes to a good ſhop, there by degrees he creeps on for perhaps two years before a good jobb is put into his hand; if he is aſſiduous, and turns it quick out of hand, he is kept at that ſort of work as long as he ſtays at that ſhop: then naturally he removes to another place, and ſees different methods; but not having capability or practice to judge for himſelf, he is led by the dictates of every foreman, till by cloſe application to his room, learning to draw all the time, and with a continuance for ſeven years in *London,* he may ſay, that he is a good journeyman, and can execute any deſign or drawing given well.

When this is done, there are 9 years elapſed after his apprenticeſhip. Perhaps his father may be dead; the ſituation he propoſed for him, occupied by another; the connections and families whoſe intereſt he depended on, are ſcattered, and no likelihood of doing any good in the country; the filial tenderneſs of his parents, by long abſence, is probably abated; and as there is no chance of his being a maſter there, his friends adviſe him to do ſomething in *London.* But ſuppoſing it not ſo, and that there was a chance of his being a maſter in the country, when he was qualified, as every man will (if there is a poſſibility) naturally tend towards home, where his friends or intereſt lie, eſpecially if he lives to a thinking age: the gay luxuries of the town may indeed for a time attract, and lull a man into a dream of inſenſibility; but once awaked from this,

this, his thoughts immediately turn upon his happiness, which can in no-wise be established but where his interest lies.

But all this time my hero before-mentioned, if he has the opportunity before observed, is not the least qualified for the undertaking. "Why not?" says his father; "if he can do any thing well, he is certainly fit for a master."—I answer, No. The principal requisites of a master, he is quite at a loss for; which are, Estimating the consequence of building in general, the value of the different artificers work, their modes of measurement, as well as the established maxims of practice in all the branches; without a knowledge of which he will ever be at a loss:—and how to come at those is almost as difficult as the practical part of his business.—There is no way to make himself master of them, but by a great expence; or if he is qualified to commence clerk to some great shop, where he may have the advantage of over-hauling his master's books and connections, such an opportunity pursued with diligence, and by comparing the remarks within his own experience, he may in time fish out such a knowledge as may enable him to understand enough to be a master, if he has wherewithal to push himself forward. But then there is the chance of procuring business, and other incidents in life, before a man is assured of getting a proper provision for a family.

Just at the time when other professions, that have opportunities and circumstances in life, are thinking of retiring, a carpenter and joiner has learnt but just enough to set up master; and all this time the person mentioned must be cut out for business, void of every principle of extravagance, or he could not arrive to this in any time during the course of his

his life, but be confined to a state of servitude and hard labour as long as he lives; which is the unhappy case of hundreds at this time in *London*. — Numbers, to my knowledge, that have most of the capabilities mentioned, and have undergone the same regimen to attain them, are now working for the poor pittance of 17s. or 18s. per week; and because they mistook their path, and entered into a flattering state of happiness by marriage, before they were well apprized of the fatal consequences, are now consigned to all the horrors of poverty and despair, never to be relieved till death.

Any reasonable man that will properly consider the above-mentioned case, will rather approve than condemn my undertaking, for endeavouring to give every journeyman a knowledge of the principles and advantages of his business. None but the masters can reject it; and only those who are not content with a tradesman's profit. But let who will disapprove of the plan, I am conscious of the rectitude of my intent, and have long considered it as an indispensible duty to do so much for the universal benefit of mankind.

LECTURE XVI.

Of the PRACTICE *of* BRICK-WORK.

THE utility and common practice of building all our edifices of brick, both in *London* and the country, arises from motives too obvious to need a definition; since it is generally considered to be much the cheapest, as well as the most eligible substance that can be invented for the purpose, both in point of beauty and duration, and inferior to nothing but wrought-stone.

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The great principle in the practice of brick-work lays in the proclivity, or certain motion of abſolute gravity, cauſed by a quantity or multiplicity of ſubſtance being added or fixed in reſiſtible matter; therefore naturally tends downwards, according to the weight and power impreſſed. From which obſervations, the requiſite inferences may be drawn, and ſuch remarks made, as may enable the journeyman to erect his works with ſuch accuracy that no bad conſequences may attend, and, moreover, avoid unnatural ſettlements.

And firſt it may not be amiſs to conſider the motive of this above-mentioned proclivity; which is chiefly cauſed through the yielding mixture of the matter of which mortar is compoſed, and cannot well be reduced to any ſyſtem of certainty; becauſe the abſolute weight of a brick, or any other ſubſtance laid in mortar, will naturally decline according to the ſubſtance or quality of it; in which place particular care ſhould be taken, that it is of a regular quality all the way through the building; and likewiſe that the ſame force ſhould be uſed to one brick as another; I mean the ſtroke of the trowel; a thing, or point in practice, of much more conſequence than is uſually thought of: for if a brick be actuated upon by a blow, it will be a much greater preſſure upon it than the abſolute weight of twenty bricks; before which can be properly laid, in form and arrangement, with the advantage of the weather in a favourable ſeaſon, may be ſo dried or conſolidated that no ſettlement can enſue from other defects than that of an over-ſight in the foundation, which muſt be adhered to, and prevented by the methods laid down of foundations, in my lecture of ſtrength. The many bad effects that ariſe from mortar not being of a proper quality, ſhould make maſters

masters very cautious in the preparation of it, as well as the certain quantity of materials of which it is composed, that the whole structure may be of one substance.

There is one thing which often causes a bulging in large flank-walls, especially when they are not properly set off on both sides; that is, the irregular method of laying bricks too high on the front edge; that, and building the walls too high on one side, without continuing the other, often causes the above defects. Notwithstanding, of the two evils this is the least; and bricks, if any thing, should incline rather to the middle of the wall, that one half of the wall may be a shore to the other. But this method, too much followed, will be more hurtful than beneficial; because the full width of the wall doth not take its absolute weight, and entirely removes the specific gravity from its first line of direction, which in all walls should be perpendicular and united; whereas if the above method is stretched to excess, and the walls have a super-incumbent weight to bear adequate to their full strength, a disjunctive digression is made from the right line of direction; the conjunctive strength becomes divided; and instead of a whole or united support from the wall, its strength is separated in the middle, and takes two lateral bearings of gravity; each insufficient for the purpose; therefore, like a man over-loaded either upon his head or shoulders, naturally bends and stoops to the force impressed: in which mutable state the above grievances usually happen.

Another great defect we frequently see in the fronts of houses; in some of the principal ornaments of brick-work, viz. arches over windows, &c. and which is too often caused by a want of experience in the rubbing of them; which is the most difficult

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part of the branch, and ought to be very well considered.

The faults I mean, are the bulging or convex situation we often see arches in, after the houses are finished, and sometimes loose in the key or center bond. The first of these defects, which appears to be caused by too much weight, is in reality no more than a fault in the practice of rubbing the bricks too much off on the insides: for it should be a standing maxim (if you expect them to appear streight under their proper weight) to make them the exact gauge on the inside, that they bear upon the front edges: by which means their geometrical bearings are united, and all tend to one center of gravity.

The latter observation, of camber arches not being skewed enough, is an egregious fault; because it takes greatly from the beauty of the arch, as well as its significancy. The proper method of skewing all camber arches should be one third of their height. For instance: If an arch is 9 inches high, it should skew three inches; one of twelve inches, 4; one of 15 ditto, 5; and so of all the numbers between those. Observe, in dividing the arch, that the quantity consists of an odd nnmber: by so doing, you will have proper bond; and the key-bond in the middle of the arches: in which state it must always be, both for strength and beauty. Likewise observe, that arches are all drawn from one center; the real point of camber arches is got from the above proportion. First, divide the height of the arch in three parts; one is the dimensions for the skewing; a line drawn from that through the point at the bottom to the perpendicular of the middle of the arch, gives the center; to which all the rest must be drawn.

There are many other difficult jobbs in brick-work:

work: as groins, niches, circular arches upon circular plans, &c. all which I shall mention in time and place.

And, first, of Brick-groins.

A groin is the intersecting or meeting of two circles, &c. upon their diagonal elevations drawn upon the different sides of a square, or any other figure, and whose principle of strength lies in the united force of elevation; divided by geometrical proportions to one certain gravity; which is the center to which all the bearings tend.

The difficulty that attends the execution of a brick-groin lies in the peculiar mode of appropriating proper bond at the intersecting of the two circles as they gradually rise to the crown, to an exact point; in the meeting or intersecting of those angles will be formed a kind of rib in the inside, which should be particularly streight and perpendicular to a diagonal line drawn upon the plan.

There is no definition of a thing of this sort, either by lines or description, equal to what will occur to the learner in the practice of them. After the centers are set, let the bricklayer apply two or three bricks to an angle; by which means he will effectually see how to cut them as well as the requisites of bond.

There is nothing so certain as practice for the solving any difficulty; it is by this axiom that every proof is founded, and without which the most flagrant idea of lines, and theoretical speculation, would be in many cases defective; because a false notion, or a wrong conception, might lead the wisest man into an error.

It is upon this principle of practice, I propose to

bring my analyſis to the underſtanding of the moſt illiterate; by eradicating all ſuperfluous lines ſet down by architects, and only point out ſuch rules of reaſon and practice as may ſuit the weakeſt to proceed by. Notwithſtanding, I muſt own that lines are the baſes of all mechanic powers, arts, and practices; yet there are hundreds of uſeful members of the community that never have it in their power to acquire the proporties of one; yet with practical inſtructions may make uſeful journeymen, and be taught to do any thing tolerably: but the inſtructions muſt be given in a manner ſuiting their capacities, and (as I before obſerved) by practical rules.

To pretend to ſhew numbers of bricklayers lines for doing their work, you may as well ſhew them Arabic: the ſame may be ſaid of hundreds of carpenters, &c. If it was poſſible for journeymen to underſtand beyond what I have mentioned, we might long have bid adieu to all commentators; ſince *Palladio* left rules ſufficient for men to work by. But theſe would not anſwer the purpoſe of the ignorant; nor has any author yet, either ancient or modern, been clear enough for a common journeyman to underſtand them; there being always ſome points, which are the requiſites that lead directly to the matter, omitted; and which but few, that have an inferior genius to the author himſelf, can find out; yet are ſimple enough in the main; but for want of being particulary noticed, have hitherto eſcaped thouſands. To ſet all theſe things in a proper degree of light, is the purport of the following deſign; and I ſincerely wiſh it may have as good an effect as it is univerſally intended.

But to return to the groins. The workman muſt obſerve, that the manner of turning groins with reſ-

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pect to the ſides, is the ſame as other arches and centers, except in the angles, which muſt be traced for its properties, as I have obſerved by applying the bricks; and if the arch is to be rubbed and gauged, you muſt divide each arch into an exact number of parts, and extend the lines till they meet in the groin: by which means you will eaſily find the curve for the angle, from which you muſt make your templets: obſerve, in fixing the centers, that the carpenters raiſe them ſomething higher at the crown, to allow for ſettling, which frequently happens; ſometimes by the preſſure upon the butments, otherwiſe from the length of the crown.

Obſerve in building of vaults, that the piers or butments are of ſufficient ſtrength; all butments to vaults, whether groined, or only arched, ſhould be one ſixth of the width of the ſpan; and, moreover, if there is any great weight to be ſuſtained, bridgings of timber ſhould be framed to diſcharge the weight from the crown of the arch: after a vault or groin is finiſhed, it is highly neceſſary to pour on a mixture of terras, or lime and water, on the crown; and give it ſome little time to dry, before you ſtrike the centers, in order to cement the whole together.

Rough groins have no more value put upon them than common vaults, which are included at per rod with common brick-work, except the angles of groins, which are meaſured after run lineal, and ſometimes allowed by ſurveyors 1s. per foot; many maſters charge 1s. 2d. But as the ſtuff is reckoned and valued in the common meaſurement, and a man will cut and turn 10 feet run in a day, 8d. per foot ſhould be the ſtipulated price for rough groins: which will pay for the waſte of ſtuff, and allow a ſufficient profit to a maſter.

Groined

Groined vaults rubbed and gauged are worth 1s. per foot ſuperficial, and the run of angles 2s. 6d.

Of a Nich in Brick-work.

A nich is the inner or concave quarter of a globe, and uſually made in walls on the exterior parts of a building, to place figures or ſtatues in. The practice of this in brick-work is the moſt difficult part of the profeſſion, on account of the very thin ſize the bricks are obliged to be reduced to down at the inner circle, as they cannot extend beyond the thickneſs of one brick at the crown or top; it being uſual, as well as much the neateſt method, to make all the courſes ſtanding.

The moſt familiar way to reduce this point to practice, is to draw the front, back, &c. and make a templet of paſteboard, after you have divided the arch for the number of bricks. My reader muſt obſerve, that one templet for the ſtanding courſes will anſwer for the front, and one for the ſide of the brick; and at the top of the ſtreight part, from whence the nich takes its ſpring, you muſt remember to make a circle of the diameter of 8 or 9 inches, and cut this out of paſteboard alſo, and divide it into the ſame number of parts as the outward circle; from which you will get the width of your front-templet at the bottom. The reaſon of this inner circle is to cut off the thin conjunction of points that muſt all finiſh in the center, and which in bricks could never be worked to that nicety; it being impoſſible to cut bricks with any accuracy nearer than half an inch thick: within the inner circle the bricks muſt be lying. It will be neceſſary to have one templet made convex, to try the faces

faces of bricks to, as well as ſetting of them when they are gauged.

The ſtone you rub the faces of the bricks upon, muſt be cut at one end in the exact form of the nich, or it will be impoſſible to face them proper. The bevel of the flat ſides of the bricks is got by dividing the back into the number of parts with the front, and all ſtruck to the center: from the circle of the front of one brick ſet your bevel, which will anſwer for the ſides of the whole. Obſerve, that the bricks hold their full gauge at the back, or when you come to ſet them you will have much trouble.

Jobbs of this kind are very rare: and when they happen, ſhould bear a price equal to their value, which ſhould not be leſs than 3s. per foot, and allowed double meaſure.

A Circular Arch upon a Circular Plan.

There is not the difficulty in an arch of this conſtruction in brick-work, that is uſually conſidered; the principal thing to be thought of, is the ſcheme for ſtriking the front of the bricks, which once properly underſtood, will render the practice exceedingly familiar.

There is another conſideration to be obſerved, which is the ſoffit of the bricks to theſe arches, and muſt bear the exact gauge behind as before, in order to ſecure the ſtrength and key, that the arch may have no inclination to a center, otherwiſe than what tends to its gravity. The beſt practical method I can allude to, is, after you have divided the arch, and ſettled your bond in front, make two moulds to the ſweep of the wall, after fix 2 uprights of wood a little above the top of the arch, at the

top

top fix one, and let the other be moved down to the top of the courſes as they gradually riſe; then with a rod, with a prick in the end, clapped cloſe to thoſe two ribs, ſtrike the top-ſides of every brick; the under-ſide may be marked by the preceding brick: and in this manner proceed all the way, till you get to the top, which will give the exact curve required to the wall and perpendicular to the ground plan.

A cimma eleptical arch, upon the above plan, may be executed in the ſame manner reſpecting the front, and ſoffit likewiſe. Arches that ſplay in the jambs, and both riſe to one height, muſt be reduced to practice in the following manner: Firſt, Divide the arches on both ſides into an exact number of bricks; and, having drawn the width of the wall, and laid down the arches on both ſides, let fall perpendiculars from the different ends of the bricks on both ſides, and draw parallel lines into each by the ſplay of the wall, which will give the exact ſize of the bricks in the ſoffit, and likewiſe the ſplay of the face of the bricks on both ſides.

Of the Quantity of Materials to a Rod of Brick-work.

The requiſite quantity of materials to a rod of brick-work, which is the ſtandard for valuing, as well as taking dimenſions; the maſter's prices, and thoſe ſtipulated by ſurveyors, come next within our notice, as well as the juſt calculation for *London* and every capital town in the kingdom, diveſted of all the errors of ſurveyors, and extravagant exactions of ſome maſters.

And, firſt, it will not be amiſs to mention, that a rod is a meaſure of 16½ feet, which multiplied into itſelf contains 272 feet and one quarter to one brick and

and half thick, which is the ſtandard on which the price is fixed: let the wall conſiſt of what number of bricks in thickneſs ſoever, they are always reduced to a ſyſtem by the following rule:

Multiply the ſuperficial content of the wall by the number of half bricks it contains in thickneſs; and divide that product by 3; the quotient will be the content in feet, to the ſtandard. — Laſtly, divide that quotient by 272, the number of ſuperficial feet in a rod, and the laſt quotient will be the content in rods, and the remains feet. See the example:

Suppoſe the dimenſions of a wall was 64 feet 6 inches by 24 feet 6 inches, and three bricks thick, firſt multiply 64 feet 6 inches by 24 feet 6 inches, the product is 1580 3, which I multiply by 6, the number of half bricks the wall contains; the product is 9481 feet 6 inches, which I divide by 3, the number of half bricks in the ſtandard; the quotient is 3163 and 2 parts; which I divide by 272, the number of ſuperficial feet in a rod; the laſt quotient is 11 rods and 71 feet.

```
      64  6
      24  6
    -------
     256
    128
      32  3
     12
    -------
    1580  3
          6
---------------------
3 | 9481  6 | 3160
    9
  -----
    4
    3
    -
    18
    18
   ---
     1
     -
```

```
272 | 3160   2 | 11
      272
      ———
       440
       272
      ———
       168
      ===
```

```
68 | 168 | 2
     136
     ———
      32
     ===
```

Whenever it happens that there is a large remains of feet, you muſt divide them by 68, the number of feet in a quarter of a rod, which will bring you nearer, if you have but one number: if many, add them all together: and this rule will ſerve for every ſubject. According to a wall of the above dimenſions, the quantity of reduced brick-work is 11 ſquare, 1 quarter, and 3 feet, as in the margin.

Sq.	Q.	Ft.
11	2	32

Note. Though a rod contains 272 ¼ feet, the quarter is always rejected: then divide by 272, which is near enough for brick-work, as a quarter of a foot, ſtuff and labour, cannot be worth more than two-pence, whice is too trivial to mention in an eight pound matter. The ſame of the parts of a foot to be divided, as in the above example.

Having given an example of meaſuring brick-work, in order to come at the value we muſt conſider the quantity as well as the quality of the materials along with the exact time it takes to execute it.

And, firſt, of materials. My reader muſt obſerve, that to every rod of brick-work is required 4400, and of ſome (as bricks vary much in ſize) 4500 of bricks, one load of lime, or 32 buſhels of lime, and two loads of ſand, which is the neareſt general

general calculation that can be made. I have, notwithstanding, seen bricks of such a size that 4000 of them would have walled a rod: but those are rarely to be met with; therefore we must abide by the above number. The same of lime and sand, which may vary a little according as they are in goodness.

There are two sorts of lime; the one made of chalk, the other of stone: the latter in point of strength and quality deserves much the preference. There are also different sorts of sand, and equally good; but that which ought to be preferred for building is river-sand, and is much the best in a strong current, Of this you may put three of sand to one of lime that is made of stone; if of chalk, only two of sand, and one of lime. There is a kind of white pit-sand in many counties; but it is not so good as red.

My reader must observe, that with regard to materials no universal standard can be found, because bricks and lime vary in every county; therefore I shall fix a price for a rod of brick-work in *London*, and after make a table to serve the country, according as materials vary in value. But first let us enquire into the labour which a rod of brick-work requires.

My reader must allow, that in order to settle a general plan for labour, we must either account the mean proportion of time, or stipulate the best wages to the least that reason can allow; which, to a good journeyman of 3s. per day, will take 4 days, and the like quantity or length of time to a labourer, besides the making the mortar, &c. Next, my reader must observe, that bricks in *London* are per thousand from 1l. to 1l. 10s. therefore we will not hesitate in this, but take a mean of 1l. 5s. for

our ſtandard-price, and lime we will reckon at 5d. per buſhel, and ſand 4s. per load; which are about the neat prices. The reaſon I chuſe to mention lime by the buſhel, is to give a clearer light into this matter than I ſhould by mentioning it either by the bag or hundred, becauſe every county hath a juſt knowledge of the buſhel, and few of bags and hundreds. But to the point:

	£.	s.	d.
4,500 of bricks, at 1l. 5s. per 1000, is	5	12	6
32 buſhels of lime, at 5d. is	0	13	4
Labour of trowel-hand at 3s. per day, 4 days,	0	12	0
Ditto a labourer at 2s.	0	8	0
Making the mortar to ditto	0	3	0
	7	8	10

By the above ſtipulation we find that 7l. 8s. 10d. is the neat price which a maſter pays out of his own pocket, beſides the loſs of his tools, as, ſhovels, ſcreens, the wear of cords, poles, puttocks, &c. which are always upon the waſte, and boards, his own time, and the laying out of his money; therefore for materials of the above quality a maſter in juſtice ſhould have per rod 8l. 10s. But in order to come at a real ſtandard of prices for brickwork in any county, I beg my reader to have recourſe to the following table, calculated as univerſal, allowing the maſter for lime, ſand, and making the mortar, 1l. 3s. and for labour 1l. 5s.

An

An universal Table of Brick-work, allowing 1l. 3s. Mortar, and 1l. 5s. Labour.

Bricks per 1000.	Mortar &labor.		The price.		
S.	*£.*	*s.*	*£.*	*s.*	*d.*
At 10	2	8	is 4	13	0
11	Do.		4	17	6
12	Do.		5	2	0
13	Do.		5	6	6
14	Do.		5	11	0
15	Do.		5	15	6
16	Do.		6	0	0
17	Do.		6	4	6
18	Do.		6	9	0
19	Do.		6	13	6
20	Do.		6	18	0
21	Do.		7	2	6
22	Do.		7	7	0
23	Do.		7	11	6
24	Do.		7	16	0
25	Do.		8	0	6
26	Do.		8	5	0
27	Do.		8	9	6
28	Do.		8	14	0
29	Do.		8	18	6
30	Do.		9	3	0

The above table I have calculated to ſerve the country, and ought to be the ſtandard in town, when there are no extraordinary exceptions, as fronts with particular breaks, which are attended with much trouble, &c.

If

If a master-bricklayer stipulates his work all at one price, as fronts, foundations, and party-walls, one thing will make amends for the loss of another. The price should be what I have mentioned prior to the table; though masters would grumble at this price; because being only allowed 1 l. per rod profit, which I think very sufficient; for by this rule, if a master can but employ 12 trowel-men the year round, his business will be a good 500l. per annum, allowing one hundred per ditto for bad debts, and keeping up his scaffolding.

Whether this is sufficient or not I leave to the judgment of the world.—But I say, if from such prices (which are considerably less than many masters have) these genteel profits arise, what shall we say to 10 l. and 12 l. per rod, which I have known many bricklayers charge for common brick-work? but the last is exorbitant, and ought to be utterly abolished.

There are, indeed, particular jobbs, as warehouses of a particular height that stand close to the Thames, where one labourer is not sufficient to half-serve one bricklayer, and where double the trouble is required to erect the scaffold, &c. In such cases 12l. per rod may not be amiss.

I would not willingly infer, or be supposed to insinuate, that the above prices should be lowered; but will take the liberty to say, if a master is allowed 9 l. or 10 l. per rod, he ought to augment his journeymen's wages; a thing which ought to be maturely considered in every branch of building.

I make no doubt but some people will wonder how I can so easily reconcile this giving as much for labour to a country master as a *London* one, in a business like a bricklayer, and so easily attained. To the person that makes this objection, I give the following

following anſwer; that there is a ſlight in brick-work as well as in every other practice, and that bricklayers in *London* are obliged to do one third more work than in the country is ever deſired: beſides, in point of labourers with regard to their prices, which in *London* are conſiderably more than the country, and with juſtice too; for could you have a country labourer in *London*, you would find he would not be able to half-ſerve a bricklayer without a year's experience. A rod of brick-work in the country is, by men that have not had *London* practice, 5½ days work, and in ſome places 6; nay, I have even known a bricklayer in the country, and who was eſteemed a good workman, to be 8 days over walling a rod, and all this time a labourer to attend him; which, if we rightly conſider, will produce the country maſters leſs profits by much, and not have work for half the number of men.

To a gentleman that finds his own materials, ſcaffolding, &c. a maſter ſhould have from 1l. 8s. to 1l. 16s. per rod labour; according to the goodneſs of the work, The ſtandard price by many ſurveyors is 1l. 10s. The maſter's prices, where no ſurveyor is concerned, are from 1l. 16s. to 1l. 18s. which will allow for men to have 3s. 6d. per day, which ought to be the journeymen's price, as bricklaying is but an half-year's buſineſs.

Of Tiling.

As there is nothing in the practice of Tiling beyond what a journeyman might have acquired in the courſe of his apprenticeſhip, and as things of more material conſequence will ſhortly come within our deſcription, I beg to be excuſed ſaying further of tiling than the quantity: and that the principal judgment

judgment of it lies in the peculiar pitch of raiſing the eaves, ſo that the tiles lay cloſe at the bottom-edge. There is alſo ſome little difficulty in laying a valley with plain tiles; but after the practice of one or two, it is eaſily reconciled. The ſame of paving with bricks.

Plain tiles to a ſix inch gauge will take to cover a ſquare 760, one peck of tile-pins, two buſhels of lime, five buſhels of ſand, five hundred of nails, one bundle of laths, and one day's work of a trowel hand, and labourer at leaſt one. We will allow plain tiles per thouſand from 17s. to 22s. but we will reckon them at 1l. per ditto.

		s.	*d.*
700 plain tiles are		15	0
2 buſhels of lime, at 5d.		0	10
5 buſhels of ſand we will call		0	6
400 of nails, at 1½d..		0	7½
Laths, one bundle of oak 1s. & 10d. of firr 1s. 3d.		1	3
Hair — —		0	2
A bricklayer one day		3	0
A labourer ditto		2	0
One peck of tile-pins		0	8
	£. 1	4	0

By the above calculation we find the neat price of a ſquare of plain-tiling ſtands a maſter in 1l. 4s. 0d. ½; therefore to a thing of this gauge we muſt allow to a maſter per ſquare 1l. 9s.—to a ſeven inch gauge, 1l. 6s.—to an eight inch gauge, 1l. 3s.

Pan-tiles

Pan-tiles are per thousand from 3l. to 3l. 10s. 150 of which will cover a square. — Gutter-tiles from 11s. to 15s. per hundred. — Dutch glazed pan-tiles per hundred from 12s. to 16s. — If we account of pan-tiles 150, at 7s. per hundred,

	£.	s.	d.
To 150, at ditto — —	0	10	6
100 of nails — —	0	0	5
Lime, hair, and sand, for pointing,	0	1	6
Laths to a square —	0	1	8
To tiling and pointing, one day a trowel-man and labourer,	0	5	0
	0	19	1

We find the advance-money to a square of pan-tiling is 19s. 1d. therefore the master's price should be 1l. 4s. and with Dutch pan-tiles 1l. 12s.

	£.	s.	d.
The master's prices for plain-tiles, is, for a 6 inch gauge,	1	11	0
By surveyors — —	1	8	0
To a 7 inch ditto, masters,	1	8	0
Surveyors — —	1	6	0

Old plain-tiling, ripped and new-laid, from 15s. to 18s. per square. Pan-tiling, with old pan-tiles, 10s. or 11s.

Of Paving.

	s.	d.
Paving with place-bricks laid flat, and without mortar, per yard	1	2½
Ditto with mortar —	1	5

Note, 32 bricks will pave 1 yard 64, edge-ways.

	s.	d.
Paving with white bricks —	1	6
New Flanders brick-paving per yard. Note, Flanders bricks are 1l. 1s. per thousand,	3	6
9 inch pamment-paving, per yard,	2	6

All rubbed and gauged arches, either of red or grey stocks, the master's charge per foot superficial, is, from 1s. 4s. to 1s. 6d. Note, a good journeyman will rub, gauge, and set in puttey, one day with another, 8 feet; the materials to ditto are worth per foot superficial 4½d. So we shall find by this sort of work a master may well afford to advance the wages.

	s.	d.
Surveyors allow per foot	1	4
Plain facios per foot rubbed	1	0
By surveyors sometimes only	0	10
Master's charge —	1	2
Brick cornices per foot superficial	3	6
Some — —	5	0

Having said so much of bricklayers work, I shall mention two or three necessary things to journeymen, and proceed with my next lecture; which is, first, that he will have a respect to the building in general; and not be backward in assisting with the bond-timbers, lintels, wood-bricks, discharging-pieces, tassels, &c. and put all in their proper places, which he should be as well apprized of as the carpenter, both as to consequence and place. The first place of bond-timber, in every story, is for the skirting or base-moulding to be fixed to; the next for the sur-base. This is of use as to strength. In the next place there should always be a chain

a chain of bond-timber between the floor or ſtory-plate, and the ſur-baſe; and run quite through the windows, &c. well bound in the angles; and not cut off in the windows, till the houſe is covered in; beſides in the windows it will be of uſe to ſcaffold upon.

Secondly, that the bricklayers omit not to try if their work is level every four or five courſes; a matter of great conſequence, as well for the ſtrength of the fabric, as the benefit of the carpenters, in laying on their plates for the floors; that inſide walls be as ſtreight as thoſe without; chimnies, quoins, and breaſts, perpendicular: that you be particularly careful in ſetting ſaſh-frames, if they ſtand in the wall, both as to regular margins from the outward part of the wall, as well as exactly perpendicular: for on this laſt article depends all the beauty of the inſide work; every thing being fixed from, and guided by the ſaſh-frame: for the leaſt defect in this, often cauſes ſhutters to be framed of different widths, as well as obliges the carpenters to make unneceſſary furrings.

And, laſtly, of the beauty of walling; which depends on a regularity of bond, an exact point, and cleanlineſs of execution; with regard to a regular bond, I mean the exact uniformity that one courſe bears to another: that the heading-joints, both of header and ſtretcher, may appear ſtreight one above another, from the top to the bottom; thus regularly broke every other courſe: that joints be of a regular thickneſs all the way up, and not bigger than $\frac{3}{8}$ of an inch: that fronts under windows do not in thickneſs exceed the inſide of the ſaſh-frame, to prevent the carpenters from ſhaking the whole front with cutting away for their dado: that you

be alſo careful to tie the angles of the building, for they are the pillars and ſtrength of the whole.

LECTURE XVII.

Of the Practice *of* Plaisterers-work.

THE branch of plaiſtering is practically conſidered under two heads, relative to the diſtinction of workmen; as, ornament, and what are called cornice hands; both having an extenſive field for cultivation. To the former of theſe ingenious departments is referred the ſtudy of all nature, to the latter the exact ſymmetry and beauty of architecture.

The principal thing in the practice of common plaiſtering, is a thorough knowledge of the quality of materials; and how far they are ſubject to the inclemency of weather; becauſe on this particular depends the compoſition of the ſtuff; and how to apply a certain quantity or gauge of plaiſter, to a quantity of lime and ſand, that may anſwer in all ſeaſons of the year. Thoſe who would deſire to have their work appear ſound and firm, will pay a reſpect to this particular; for it is certain, that in winter, or very damp weather, ſtuff will require a double gauge of plaiſter, more than the exact quantity that is neceſſary to be applied in all common ſtuff for cornices, ceilings, &c. which is the ground of all works of this ſort; and if any wiſe defective, will be too powerful for the ſetting or finiſhing of puttey, that is applied over the whole; and ſhould appear without crack or bliſter.

Plaiſter is of a very aſtringent quality; that of it which is good, is an immediate cement, like terras. But though work be forced by an augmented quality

quality in unſeaſonable weather, for my own part, I would prefer a good ſeaſon for natural drying unto any thing confined by artificial means; and would conſider one bag of plaiſter in May to ten in January or February, for either cornices or boſſing of ornaments. The way and time to mix plaiſter with ſtuff, is to do it at the time you lay it on; in which caſe it will have all its ſtrength. Plaiſterers themſelves know well enough the uſe and mode of mixing their ſtuff; but as I propoſe my book as an univerſal benefit, I beg to mention two or three things relative to the quality and quantity of materials, that may be ſerviceable to many workmen, that do plaiſterers work in the country; which is even beneath the notice of an eſtabliſhed plaiſterer.

The mode of appropriating ſtuff for the firſt coat of ceilings, is, to take one quantity of lime to three of ſand. Note, the beſt ſand for ceilings, walls, &c. is red pit-ſand; which is of a rough conjunctive quality, and the leaſt ſubject to crack of any. For ſtucco, or what is called finiſhing, mix one of lime, and another of ſand: the beſt for ſtucco is river-ſand; being much ſharper, and ſets, as is required, much harder; for in all work of this kind it is expected to appear as ſmooth and firm as ſtone.

For cornices, the certain quantity ſhould be one gauge of plaiſter, and four of lime; and ſand, three to one of the whole; the lime, ſand, and hair firſt made; the plaiſter to be applied juſt before it is laid on; the ſame for boſſings of ceilings, &c.

Plaiſtering is a moſt uſeful invention, and has greatly the preference of wood, for cornices, &c. on account of its unity with walls and ceilings; but we ſee it often loſe its effect, when mixed with wood, as in baſe mouldings, &c.

The intent of appropriating caſt-mouldings of plaiſter,

plaister, with wood, is to load a room with a profusion of ornaments, and at a little more expence than if done with wood plain: but things of this kind will not bear examining: and, for my own part, I think every ingenious man would rather approve of half the quantity of ornaments well executed in wood, suitable, and of the same piece with the rest. —Belexion mouldings, well executed in plaister, have a noble effect in halls, stair-cases, &c. and are much preferable to any thing of the same value, that can be invented. These, with some well disposed ornaments, &c. in them, would, in my opinion, be the greatest beauty of the present mode of finishing many capital rooms.

To the immortal credit of the present age, it may be affirmed, that this branch of business is in its full meridian of beauty, both with respect to symmetry and composition; and it may justly be said, that the ancients were in no wise compatible with the present taste for ornaments; in which case Messrs. *Adams* deserve particular honour; being themselves the originals of many capital designs, that almost beggar description: from the spring of which the whole mass of surveyors, and petty mixturers, have found matter to supply their want of genius and invention.

It is greatly to be lamented, that these great men should mistake their path in some respects relative to the propriety of their cornices; which greatly lose their force for want of a little more projection: that symmetry, and happy arrangement, which we frequently lose by the distance, would be quite perspicuous, were but a little more added to the above particular. I almost wonder that such great judges of beauty, never found the ill effects of this observation; but whether or not, it is beyond a doubt

doubt, their works in general are the most capital of the age.

Of the Value of Ornaments.

The value of ornament-plaistering cannot well be ascertained without a sight of the drawings; or rather the ceilings, &c. when finished. However, as far as may be serviceable to the learner in estimating a jobb, I will endeavour to define.

And, first, my readers will observe, that all ornaments on ceilings are valued by the foot; and it may not be amiss to observe, that if the ceiling is lightly enriched with foliage of small relief, intermixed with mouldings of various figures, it may be valued all together by the foot superficial; the dimensions taken from the outward square of all, at 3s. per foot. But this is an uncertain way, and cannot be used by any but those that are judges at sight. The only real method is to value all the different works separate, as before observed in the measurement; and are, or may be done at the following prices:

	£.	s.	d.
Plain mouldings in cielings, at per ft. run	0	0	2 ½
Inferior enriched mouldings to ditto, cast,	0	0	3
Superior enriched, cast,	0	0	4
Ditto run upon the cieling, with various enrichments, from 7d. to	0	1	2
Foliage, at per foot superficial, from 2s. to	0	3	6
Large pieces of ornament in the middle of a ceiling, at per foot superficial,	0	4	0
Trophies, cases of arrows, &c. per foot superficial ——	0	5	0
Figures, deities, &c. per piece, from 1l. to	20	0	0

Gollocci

	£.	s.	d.
Gollocci and frets, at per foot superficial, 6 inches wide,	0	2	0
Ribbons and roses, superficial, at	0	1	6
Large ornaments of festoons and flowers	0	3	9
Small frets, at per foot run, from 6d. to	0	1	0

My reader must be content, in ornament ceilings, to know the real value of the works I have mentioned, as it would be of little validity to prove assertions that he does not see, or may be unacquainted with; therefore to make it advantageous to him, it will be highly requisite to study this matter farther himself.

Of the Value of Plaister-cornices.

In the value of Plaister-cornices it may not be amiss, first, to enquire into the quantity of materials, for a better proof of what I propose to advance relative to the price allowed by surveyors, and what is also charged by masters.

And, first, of full enriched Corinthian cornices, which consist of various ornaments, carvings, &c. and should be made all of the best plaister, which is little less than one penny per pound.

The nearest general calculation that can be made of plain cornices, on account of their number of variations, is, To every foot of plain cornice the materials, making, &c. stands the master in 4d.— To a full enriched cornice, modillions, &c. 1s.— The labour to a foot of Corinthian cornice, as I have made the following calculations from whole rooms, the labourer's time, laths, nails, stuff, lime, and plaiisterer's time, to be as follows:

To

	s.	d.
To labour ——	0	9
Stuff —— ——	1	0
Therefore it cannot be amiss to allow the intrinsic value per foot superficial	2	0
Some surveyors are pleased to allow	1	6
Others vouchsafe to give	2	2
Some I have known generous enough to offer a good plaisterer per foot superficial	1	2
Some of the capital masters in town, for fully enriched cornices of the Corinthian or Composite order, from 2s. 8d. to	3	0
Ionic cornices, fully enriched, are worth	1	9
All plain cornices are worth to a master, per foot superficial, to find scaffolding,	1	2
Though they are done so low as	0	8
Doric frieses, with ox-heads and proper enrichments, at per foot superficial,	4	6
Cornices to ditto, with mutules and bells,	1	9
Surveyors 4 s. and	1	10
Enriched frieses, from 1 s. per foot, to	5	0
Cast frieses, with foliage of 4 inches, measured in the cornices, at 1s. 6d. per foot,	1	6
Belexion mouldings enriched, at per ft. run	0	4
Corinthian and Composite capitals, per foot superficial, — —	5	0
Chimney-pieces, at per foot superficial,	2	0
Ionic capitols in plaister, per foot superf.	4	6
Surveyors allow, in some cases,	5	0
Terms to chimney-pieces, per foot superf.	2	6
Frieses to ditto enriched	3	6

P Of

Of Plain-ceilings, Walls, Stucco, &c.

The quantity of materials to either ceilings or walls ever varies, becauſe it depends in a great meaſure on the conduct of the carpenters, bricklayers, &c. The following is the neareſt general calculation for every three-coat ceiling, or lathed walls: We muſt allow 5d. for materials, as laths, nails, lime, plaiſter, ſand, &c. — for la-

	s.	d.
bour, if a maſter finds ſcaffolding, 6d. more, which brings the intrinſic value, per yard — —	0	10
Therefore every ceiling well floated, &c. is worth —	1	2
Maſters charge the above price.		
Surveyors from 9d. to —	1	2
Inſide-work upon laths, as walls, &c.	1	0
Walls floated for paper, &c.	0	8
Stucco, per yard, well finiſhed on laths	1	9
The materials to a yard of ſtucco, is worth, upon laths, —	0	10
Walls floated and finiſhed with ſtucco	1	6
The materials are worth per yard	0	7½
Note, maſters charge for finiſhing upon laths — —	2	2
Upon walls — —	1	10
Surveyors allow from 1s. 2d. upon laths, to	2	0
Upon walls, from 1s. to —	1	7

	£.	s.	d.
Grey plaiſter floors are worth per ſquare, if 2 inches and an half thick,	2	14	0
Surveyors allow from 2l. 2s. to	2	10	0
Red ditto are worth per ſquare	3	8	0
Surveyors allow from 2l. 18s. to	3	5	0

The

The learner muſt obſerve, in laying of plaiſter-floors to put a margin of wood round the room, which muſt be taken up as ſoon as it is ſet, to give room for ſwelling; for if plaiſter of ſuch a thickneſs be laid and confined, it will riſe in bliſters before it is half dry, and render it totally uſeleſs.

	s.	d.
Plaiſter-framing, as ovlo and flat, per foot	0	6
Ditto circular ſoffits, meaſure and half		
Framed and raiſed pannel in plaiſter	0	9
For white-waſhing with whiting, ſize, work, and materials, per yard	0	2
Ditto whiting of new work, per ditto	0	1½

LECTURE XVIII.

Of PAINTERS WORK.

HOuſe-painting is a branch ſo common that it needs no comment; therefore I ſhall not take up my reader's time beyond what is neceſſary, to enquire into its value. And, firſt, of the colours of paint that is, or in ſome caſes may be uſed in a building; which are as follow:

Wainſcot colour,	Cedar,
Stone ditto,	Walnut-tree,
Lead,	Pea,
Pearl,	Fine ſky-blue,
White,	Mixed with Pruſſian blue,
Dead white, or flatting,	Orange,
Chocolate,	Lemon,
Mahogany,	Pink,

 Bloſſom,

Bloſſom colour,	Brown,
Fine deep green,	Yellow.
Black,	

The above are all the colours that can be requiſite for painting either houſes or ſhops, &c.— Theſe colours differ ſomething both with reſpect to price and quality; therefore muſt have a ſtipulation according to their value and quantity, in point of execution; as it is certain ſome colours will paint conſiderably more than others, which I ſhall endeavour to ſhew.

Firſt, of the price of colours.

	£.	s.	d.
Firſt primer ground in oil is ſold at per hundred ——	1	16	0
Or per pound ——	0	0	4
Second primer at ditto ——	1	16	0
Beſt white-lead ground in oil, at per lb.	0	0	4
Pearl, lead, cream, ſtone, wainſcot, at per pound ——	0	0	4½
Chocolate, mahogany, cedar, walnut-tree, ground in oil, at per pound	0	0	6
Sky-blue, orange, lemon, pink, bloſſom, ſtraw, Pruſſian blue, from 8d. to	0	1	0
Fine deep green, per pound	0	2	6
Black, brown, yellow, per ditto	0	0	4

My reader muſt obſerve, that all houſe-painting muſt at leaſt be done three times over, ſometimes four; the cauſe of which I ſhall mention hereafter.

Of

Of the quantity that one pound of paint will do over.

	Sq. yds.
First primer ground in, or made thin with oil, will paint, properly mixed, 18 square yards —	18
Second primer must be mixed stronger, one pound, mixed with oil, will paint 10 square yards —	10
The best white-lead, ground in oil, and properly mixed for the finishing, will paint 8 yards —	8

So if we add the three quantities together, and divide by 3, we shall find that one pound of paint will prime and finish, properly mixed, 12 square yards, as in the margin. Therefore, we have only the oil for mixing, and the puttey, to add; and we shall find the real value to a yard of painting; which once got, we shall proceed to the labour, to solve the whole.

3 | 36 | 12
36
—
0

Supposing to one pound of paint to be appropriated for painting to its extent, at three separate times; for first primer, second ditto, and finishing, we allow three half-pints of oil, which is more than necessary, and one pound of puttey for stopping, &c. and add them to the value of the paint, for 12 yards, and we shall easily come at the value of materials.

	s.	*d.*
To one pound of paint —	0	4
One pound of puttey —	0	4
3 half-pints of oil, at per quart 1 s.	0	9
	1	5

The

The above added, as in the margin, we find the materials for 12 ſquare yards is 1 s. 5 d. which is ſomething leſs than 1d. $\frac{1}{2}$ per yard.

And next of the labour to a yard of painting.

The neareſt calculation of the labour to a yard of painting, is as follows: — A man that will work any thing ſmart will do

First primer per day 70 yards

Second ditto, and ſtop with puttey,

And finiſh about —

Therefore if we add the three numbers together, and divide by 3, as before, we ſhall have the exact quantity that a man will begin and finiſh in one day, which in the margin is 46.

	Yards.	
	70	
	30	
	40	
3	140	46
	12	
	20	
	18	
	2	

A journeyman's wages in this buſineſs is 3 s. per day: ſo if we divide 46 yards by 36 pence, (the journeyman's wages) we ſhall find, that a maſter has every yard of painting, 3 times over, done for leſs than a penny; to which if we add three-halfpence materials, the intrinſic value of a yard of painting is 2d. $\frac{1}{2}$; for which maſters charge from 6d. to 8d. per ditto.

I am far from inſinuating, that any maſter ſhould lower the cuſtomary prices; but yet cannot help obſerving, that I think it a great error in ſurveyors to allow a buſineſs like a painter ſuch extravagant profits that neither requires thought or ſpeculation, and joiners in many reſpects not ſufficient to pay their men half adequate to their merit.

Surveyors

Surveyors allow for out or inſide-work, 3 times in oil, per yard from 6d. to 7d. The profit of every yard, allowing for difficult jobbs, is 3d. A man with a continuance, painting 40 yards per day, or ſuppoſing 30, or even 20, a maſter muſt clear by every journeyman, at ſuch prices, 5s. per day. Many maſters employ 20 men; the profits ariſing from which are obvious to every one.

	s.	d.
The real price of painting 3 times in oil ſhould be	0	4½
When clear-coated	0	5½
Flatting with turpentine	0	6½
Flatting with nut-oil	0	7½

Some of my readers may not know what either clear-coaling or flatting is, therefore I ſhall endeavour to inform them, as well as of their uſe.

Clear-coaling is a body of colour ground in, or mixed with ſize, and done after ſecond primer, in order to give a ſtrength to the colours, and make them ſtand the ſemblance they are intended. But I cannot recommend it; for damp weather will affect it; and if the colour intended is white, or any thing light, it will always turn yellow.

This compoſition, or what is called clear-coal, is a great enemy to joiners; for let them finiſh their work ever ſo clean, if the men are not very careful, clear-coaling ſpoils it all, eſpecially the mitres, &c.

Flatting is done with a mixture of oil of turpentine, or nut-oil. Its intent is to ſecure the colour, and is uſed for finiſhing; and when done, leaves the paint quite dead, without gloſs. It is of great conſequence to thoſe who like to have their rooms continue white, as nothing elſe can be appropriated to ſtand the weather.

All

All common colours are done at the above prices, and allowed as ſuch by ſurveyors: blues, greens, bloſſom, pink, orange, ſtraw, olive, pea-colour, ſhould be per yard 1 s. and are allowed as ſuch by ſurveyors.

There is nothing like this difference in the quality of materials or labour, to augment the prices 6d. per yard; but when thoſe colours are uſed, it is generally for little abſtracted jobbs, which ſhould be paid for according to the time and trouble.

	s.	*d.*
Saſh-frames are allowed, per piece, at	1	4
Might be done for	1	0
Saſhes allowed per ſquare	0	1½
Window lights from 2d. to	0	5
Inſide-painting, twice upon old work, per yd.	0	4
Modillion-cornices, per foot run, from 4d. to	0	9
Plain outſide-cornices, per foot run,	0	3
Frontiſpieces, per foot ſuperficial,	0	2
Chimney-pieces, per foot ſuperficial,	0	2
Hand-rail, baniſters, ſtrings, newels, &c. per yard,	0	10
Hand-rails alone per foot run,	0	2
Horſe plain cornices, per foot run,	0	1
All torus ſkirting in halls, garrets, &c. per foot run,	0	1½
Skirting up ſtairs, per foot run,	0	2

LECTURE

LECTURE XIX.

Of GLAZIERS WORK.

GLazing is a branch of the least difficulty of any in a building, therefore is judiciously enough joined to a painter, because neither require the executive part of men of merit.

The value of glaziers work as follows;

	s.	d.
Crown-glass measured neat for sashes, according to the size of the squares, per foot superficial,	0	11 ½
Sashes glazed with London crown glass, puttied on both sides, as is requisite, per foot superficial	1	2 ½
Sashes, glazed with Bristol crown glass,	1	1 ½
Ditto, with Newcastle glass,	0	10 ½
Ditto, waved or jealous glass, per foot superficial,	2	3
Ditto, plate glass, according to their size, from 1 foot to 2 foot panes from 5 s. to	6	0
Ditto from 2 to 3 and 4 foot panes superficial, are from 6s. per foot to	8	0
Glazing with Crown glass, squares in lead-work, per foot,	11	0
Ditto the materials to a foot of this work, is worth	8	0
Taking down leaded windows, scowering, soddering, banding, and putting in again, per foot superficial,	3	0

Note, 25lb. of window-lead is sufficient for 100 feet superficial, when worked. — Note also, that lights and circular sashes must be valued as square,

on account of the trouble; and to glaziers, in some cases, measure and half.

LECTURE XX.

Of Slaters Work.

SLaters work differs but little in practice (save the preparation of the slates) from tiling; its greatest beauty is in the regular appropriating the different gauges; so that they appear in bond, and arrangement equally streight. There is some difficulty in fitting a valley; but the great principle is the exact form of setting the first course, or raising it behind, not to excess, but to a certain pitch, that all the succeeding ones shall appear close, and not be defective in respect to the inner parts for pointing.

There are many sorts of slate in use, viz. what is called Can-quarry, Tavistock scantle, and Westmoreland ditto, and some others, though not frequently used. The latter is much the best, being much larger, but should not be appropriated but for very large buildings; or at least, such as are of sufficient strength for their weight.

	£.	s.
The price of doing these per square is, from 2l. 13s. to	3	0
Tavistock scantle are something less; and rather inferior in quality; and are according as they are in goodness done from 2l. to	2	10
Can-quarry are the worst, and mostly used, the price from 1l. 16s. to	2	8
Ditto for temples, and scheme roofs,	2	12
Ditto, slates, new ripped and laid,	1	1

There is amongst the new buildings a worse slate than

than any of those mentioned, called Welsh slate, done per square from 1l. 8s. to 1l. 13s.

LECTURE XXI.

Of CARVERS WORK.

THIS beautiful and ingenious branch is subject to the same effect as ornament-plaister, with respect to its value: no settled or stipulated price can be fixed on a matter of such mutable compositions, that constantly vary with every fresh design. —However, I shall give some few hints to the learner: and, first, with respect to carving on mouldings for all sorts of framing:

	s.	*d.*
Ovolo to deal-framing, carved with eggs and tongues, per foot running measure,	0	4
Ditto on mahogany or wainscot,	0	6
O-gee framing in deal, carved with seven-leaved grass,	0	4
On mahogany and wainscot,	0	6
Small o-gee to framing on deal, three-leaved grass	0	2½
Large ovolos to doors, with ribbons and roses, or eggs and darts, per foot run,	0	8
Large quirked o-gees, with various carvings,	0	7
Small astragal mouldings to doors, per foot lineal,	0	3
Small fluting to facios, per foot lineal,	0	5
2 inches long	0	6
Frieses, fluting, 6 inches wide and upwards, at per foot superficial,	1	6
Fluting the raisings upon the pannels of mahogany doors, per foot run,	0	8

	s.	d.
Carving Corinthian capitols, per foot ſuperf.	9	0
Ionic ditto,	6	0
Compoſite ditto,	9	0
Ornaments in alto-relievo, to freiſes well executed, from 5s. per foot ſuperf. to	10	6
Ornaments to frieſes in baſſo-relievo, from 3s. per foot ſuperficial to	7	6
Feſtoons, per foot ſuperf. from 4s. to	8	0
Figures are all valued at per piece.		

As Carvers find no materials, and have no advantages but what reſult from their labour, I ſhall not pretend to ſay any thing with reſpect to the time of execution; ſince it is a buſineſs, well known to be upon as eligible a footing, with reſpect to profits, as any in the building branch. The above prices are ſuch as are allowed by many ſurveyors.

THE

PRACTICE

OF

JOINERS-WORK.

TO

Mr. *THOMAS HARDISTY*,

Carpenter and Joiner, in YORK.

SIR,

HAVING no other inducement but gratitude, nor any motive but a willing heart, I humbly beg your acceptance of the following work, as a compenſation for the ſole produce of my labours; as I am not beyond acknowledging, that whatever progreſs I have made in the liberal ſciences, as well as my own buſineſs, was chiefly through your kind incitements to the former, and well-grounded inſtructions in the latter.

With reſpect to the plan of my work, I ſubmit to your candour, well knowing, from a thorough conviction of your goodneſs, that you will not condemn where there is the leaſt room for applauſe.

Many who have ſeen and much approved the peculiar efforts of my ſtudies, have, notwithſtanding, alledged reaſons againſt a work of this ſort without lines.—I muſt confeſs, that in many, if not moſt of the practical eſſays, I could have been much clearer, by alluding to lines; and, moreover, given a greater variety of methods and obſervations; and muſt allow, that my firſt plan was with this intent: but, conſidering the vaſt expence the book would amount to, and the number of treatiſes of lines already extant, I contracted my ſcheme, and reduced it to the preſent ſtate; well knowing that every journeyman (for whoſe benefit this work is intended) had rather be inſtructed in the modes and peculiar manners of doing a difficult piece of work, than have the pleaſure of caſting his eye upon a fine plate, that only repreſents ſuch works when done.

As no ſettled ſtandard can be made reſpecting the ſurveyors prices, and maſters, or their mode of meaſuring, being all in ſome caſes different

ferent; I hope you will give ſanction to my propoſals, which contain a medium of many, and the direct rules of ſome.

If I meet with the approbation of the world, and an encouragement from your judgment, I may, hereafter, offer to the public a ſyſtem of matters (in ſtore) never yet conſidered by any; and, in my own opinion, of the moſt eſſential utility both to the architect, builder, gentleman, and private workman.—In many of the topics I ſhall better my underſtanding by your opinion, as it is well known, that your practical methods are at leaſt equal, if not ſuperior to any of the preſent age.

Whatever the public may think of me, as one they call an author, I know not. Of this I am certain, that I ſhall not want your belief, when I aſſure you, that this dedication is the reſult of a profound acknowledgment, an artleſs inclination, proudly glad and grateful to have it in my power to offer my trifle to the acceptance of a man, whom I know to be meritorious without example; honeſt without pretence; and, what is more, never withdrew his hand from the preſſing exigence of his friends.

I am, Sir, with the moſt profound reſpect,

Your moſt obedient and moſt humble ſervant, and very friend,

THO. SKAIFE.

THE

THE PRACTICE OF JOINERS-WORK.

LECTURE XXII.

Of the CONSTRUCTION *of* DADO.

DADO is the die or intire part of an order, which is between the base and cornice of the pedestal; and by architects is attributed to that plain part of a room between the base and sur-base mouldings. This sort of work, in large rooms, should never be made of thinner stuff than what is called whole-deal.

The chief thing to be considered in the practice of dado is, the manner of putting up, which requires some thought, in order to secure it from casting; the method of keying only being found insufficient, without a proper manner of placing of them. There are a great many ways of doing this: but the best, in my opinion, is as follows, viz. when you key your dado, leave the keys long enough at the broad end to reach the joists, or floor; and put the broad-ends of the keys downwards, for this reason; there is a proclivity, or tending downwards in all work, which can never be detrimental to dado thus done; because if the key goes to the floor, there it

R stops:

ſtops; and if it ſhould ſhrink, the proclivity of the dado will ever keep the work ſtreight. If the broad ends were upwards, the dado might drop from the keys, and render them of no uſe. In putting dado round windows, mind to keep up the front of the elbow a little, that after the mouldings are on, and capped, the ſhutters may open eaſy.

Dado in all angles muſt be groved, and well nailed; obſerve alſo, that no nails be put in the bottom-edge of dado; let it receive no faſtening but what it has from the keys; if it is confined both at the top and bottom, it is ſure to break.

Obſerve, of dado for circular rooms, that you do not imbibe the wretched methods of contract-mongers and taſk-maſters, of gluing your dado up and down; the genuine method of gluing circular dado, is to make a ſaddle to the ſweep of your wall; if it is a large ſweep you may make a fineer half an inch thick, and bind it upon the cilinder or ſaddle; after glue backings to the ſweep behind: leave it a few days to dry, and ſtrike your work for putting up.

With regard to long lengths of dado, be careful in breaking the heading-joints, and, not like the taſk-maſters, make a heading-joint quite through.

As to the height of dado, the window is the guide; leaving the ſame margin when the capping is on, as there is from the ſhutter to the bead; when there are backs and elbows, the dado may be put up at pleaſure, or to the fancy of the builder. Some architects propoſe a fifth part of the height of the room; but this would not ſuit very low rooms; nor yet very high ones. I think dado ſhould never be higher than 3 feet 9 inches, nor lower than 2 feet 6 inches. If rooms were all about twelve foot high, a fifth part would do very well; and ſo on to a room of

of 15 feet high; what runs above this pitch, for every 6 inches in the room's heighth, I would add one inch more to the height of the dado. If there are columns or pilasters, the dado should in every respect be subservient to the pedestal of the order.

	s.	*d.*
The price of this work, charged by masters, is, per yard, with materials, from 4s. 6d. to	5	6
Surveyors allow for dado of whole-deal, per yard,	4	6
Inch and half ditto	5	0
Of inch ditto, per yard	4	0

The real value of dado as follows:

The stuff to dado, allowing waste, should be to a master per foot 2d. $\frac{1}{2}$; nine feet of which is,	1	10
Glue and nails to ditto, and keys, per yard	0	4
Labour to ditto, per yard	0	10
	3	0

Some people will wonder how I can fix 10d. per yard for labour; those that do, I beg them to understand, that this is the neat price a master pays out of his pocket for such work, proved by the following example:

A journeyman of 17s. or 18s. per week will glue up six twelve-feet lengths per day, plain them the second, and put them up the third, with casual breaks, &c. Therefore we find that 2 lengths is one day's work to begin and finish; which two lengths when put up, may be 6 yards; and which, allowing the master for his man 3s. per day, is but 6d.

 and

and 4d. more per yard I allow for keying ditto, which is 10d.

	s.	d.
Therefore the univerſal price of dado of inch and half deal, is,	5	0
Whole-deal ſhould be per yard	4	6
Of inch ditto	4	2

Circular dado double meaſure, and paid for the ſaddle or cilinder extra, which it is glued upon.

LECTURE XXIII.

Of Mouldings *in general.*

THE guide and maſter-piece of all architecture depends, and that ſolely, on the magnitude and compoſition of mouldings; they are the ſummum bonum, or leading touches of art, which give force and beauty to whatever is intended; every thing, of whatever ſort or nature, takes its ſemblance, or changes its effect, from the power that is contained in theſe governing principles: how cautious, therefore, ſhould every artiſt be in the deſigning or compoſing of mouldings, ſince on thoſe alone depends that ſplendid eaſe, required to attract the beholder's eye, and enliven the form of imitative nature.

The great and moſt ſenſible difference between ancient and modern architecture, is wholly compriſed in the compoſition of mouldings. Notwithſtanding ſo great and diſtinguiſhing an article to the beauty of all work, as mouldings are, we daily ſee ſuch productions of this ſort, that one would almoſt be perſuaded to think that there was no cauſe for them but cuſtom, nor any properties belonging but the form, which might be extended or contracted as ideas or fancy might guide the pen of

of the artist; and, I believe, there are many who consider themselves as adepts in architecture, who vary but little from the above observation.

Those gentlemen who satisfy themselves with opinions of this sort, are as far from the comprehension of symmetry, and real effects, as the difference between right and wrong. I own, there is a thirst for variety peculiar to the English nation, that must be satisfied, or the works of art (like the continued form of a worn-out fashion) would quickly decline, and be disgustful: therefore it is highly necessary to strive at invention, to gratify the mutable taste of such a people. But even this should be done within the rule of propriety: for excesses in any art are obnoxious.

The invention of many new members of mouldings were well concerted and introduced, by the original authors of them; but they are now prostituted to such a pitch of extravagance, that I almost wonder the inventors do not leave this by-road, (which they first ventured upon, and made familiar and smooth, to their lasting praise,) and find out some other similar path, where they may move on, for a time, without let or molestation.

The field of nature will never be exhausted, nor propriety lose its power of guidance; therefore, whatsoever bears a semblance of the former, within the circumscription of the latter, is consistent with symmetry, and hath the advantage of sound reason to fortify the invention. Any thing estranged from the above observation, deviates from the real sense of all mouldings; which are intended to give force and elegance to all works, wheresoever applied.

The present taste of mouldings (as introduced by numbers) differs much from this; for, instead of giving force and beauty, they in many cases diminish

minifh the natural grandeur, for want of proper dimenfions.

Any moulding, of whatever fort or nature, above the eye, fhould have a projection, that the whole effect of the different members may be plainly difcovered; elfe they ferve to no purpofe. It will be of little ufe to load a cornice with beads, and other fimilar quirked mouldings, if they lofe their effect by the diftance. I muft, neverthelefs, allow, that mouldings defigned in the above manner in many cafes are pleafing, but muft be judicioufly appropriated; for the learner muft underftand, that inftead of lefs, thofe mouldings require more projection than others; for it is not how thofe things will or do appear clofe to the eye, but we muft confider the diftance at which they muft of courfe be viewed; the altitude, and natural point of fight. If thefe things were maturely confidered, I believe we fhould find, that cornices of all forts fhould not confift of one of the above particulars: — architraves to doors, windows, &c. as well as bafe and fur-bafe mouldings, doors, window-fhutters, belexion and other mouldings clofe to the eye, may have thefe introductions: — cornices to rooms of all forts fhould be free; yet, if they muft be fubjected in other refpects to the tafte of the times, the learner muft obferve, never to exceed the following bounds: To make the cornice lefs than the one 24th part of the height of the room, nor project lefs than two-thirds of its height: and if the mouldings laid down by fome eminent architects are not fufficient for his tafte, I muft leave him in other refpects to his own fancy; with this point in view, not to out-ftretch the modefty of the above proportions.

Of

Of the practice of mouldings.

The working, or rather the taking-off mouldings from drawings, is a matter of ſome conſequence to learners; therefore I ſhall not ſpare to be as plain and particular as poſſible, to render this familiar to the weakeſt capacity: but muſt obſerve to the ſtudent, if he is a ſtranger to this matter, it will be requiſite to proceed ſtep by ſtep by the following example, (as deſcriptions in writing are ſometimes troubleſome to remember) and then in this, as well as all other points of practice, he will be aſſured of ſucceſs.

Example of taking-off a moulding.

Before you begin, draw a line cloſe to the face of the moulding, (not interfering with any of the fillets) next from this face-line draw a line ſquare at the extreme top and bottom of the moulding, which will give the width of your ſtuff to be plained up; from the face-line draw a line parallel, for the thickneſs of the ſtuff; next continue all the lines of the drawing into this firſt face-line; and alſo at the projection of each annulet, or fillet, let fall perpendiculars into the face-line too, which will ſhew the wood to be taken out for working your ſquares; the ſame for ſpringing both at top and bottom. Having done this, ſtrike a line acroſs your piece of wood, and with your dividers begin either at the top or bottom of the drawing, and take off theſe ſeveral marks of interſection, and prick them upon the piece of ſtuff for the moulding; likewiſe the ſpringing both at top and bottom; then ſet your gauges to theſe ſeveral pricks, and run them all

all along the piece; then proceed to work it; first taking off the springing, and set it upon the same position for working, it must be in when put up, by which means you will sink all your squares level. If there is an o-gee in the drawing, observe with your dividers to draw the curve of the hollow into the face-line, the same as the fillets, which will be your place for pricking off upon your stuff, and the extent of the hollow; which, if your round is well fitted, and worked exactly to this line, your kindred hollow, will work the round to an intersection of the greatest nicety.

There is no other moulding, save this, that requires any observation in the taking or pricking off. O-gees and faint hollows are the only difficult mouldings; with respect to the latter, whenever they occur, it is always upon a plain face, as architraves, &c. in which case, you must always leave a fillet at the bottom of the hollow, and rabbit the architrave, or other plain, where it is to be applied, because it would be impossible to work a moulding of this sort to an edge with any accuracy.

Of the value of mouldings.

	s.	d.
Masters charge for all streight mouldings, as base and sur-base, plain cornices, &c. with materials, per foot superficial, from 1s. 2d. to — —	1	6
Surveyors allow in general	1	2
Dentel cornices by masters	1	8
Surveyors — —	1	5
Block or modillion cornices, per foot, masters — —	1	8
Surveyors in many places	1	4

Blocks

	s.	d.
Blocks and modillions at per piece, according to their ſize, from 1 ½d. to	0	6
Small block cornices are valued all together, at — —	1	9
Doric intablatures all together; with mutules, trigliffs, &c. at per foot ſuperficial, maſters — —	2	6
Surveyors, from 2s. 2d. to	2	4
But theſe are uſually valued ſingly, the cornice at 1s. 2d. the trigliffs and mutules at per piece, which anſwers the ſame purport.		
Architraves, at per foot ſuperficial, by maſters — —	1	0
Surveyors, from 8d. to	1	0

The univerſal price of mouldings is as follows. To every ſuperficial foot of moulding may be reckoned, in a general caſe, ¾ of a foot of ſtuff. In ſome caſes it will require more, and others leſs, which, of good whole deal, as none elſe ſhould be uſed for mouldings, we will call ——

	s.	d.
(materials)	0	3
Brads, glue, &c. —	0	1½
The whole materials to a foot ſuperficial, is —	0	4½

	s.	d.
The labour to all mouldings worked by hand, (as the others are not worth notice) ſtands a maſter in near 4d. per foot, which makes the labour and materials per foot	0	8½
Therefore the univerſal price of all ſtreight mouldings ſhould be per foot ſuperficial — —	1	0

To prove the labour, 4 lengths of 10 or 12 feet,

 two-

two-membered mouldings, is one day's work, which may girt about three inches each, make twelve feet in the whole, which, at 4d. per foot, is 4s. above a journeyman's wages.

Circular mouldings are very badly regulated, having no more than double meaſure, which is in every caſe too little, both for materials and labour. The real value of circular work ſhould be at leaſt trebled; and, in many caſes, double meaſure, and double price.

Architraves, double-faced, to maſters ſhould be the ſame as mouldings, as both ſtuff and labour have the ſame proportions.

Single-faced architraves are made of thinner ſtuff, with a moulding glued upon them; the materials are not worth more than 2d. per foot; the labour to ditto, 2d. more; therefore the real value ſhould be to maſters,

	s.	*d.*
per foot, — —	0	6½
Many maſters charge for this work	0	8
Surveyors allow from 5d. to	0	8

LECTURE XXIV.

Of Doors.

THE nature of a door is too obvious to need a comment; therefore I ſhall immediately proceed to relate what is neceſſary to be obſerved in the practice of them.

Moſt kind of doors ſhould be put into the hands of the beſt workmen, for they are a part of the branch, which requires great execution; being always in uſe, ſhould be made particularly ſound, and firm, and well handled, becauſe they are ever

oppoſed

opposed to the eye; the great principle or chief merit lies in the ploughing, and sticking the moulding upon the frame; for without masterly performance in these two points, all your care in plaining up your stuff, mortising, tenanting, &c. will be of little use; because in those two parts lie the great efforts to a well-executed door. There are different ways of putting a door together, but the best and surest is done after the following example.

When you have plained up your stuff, mortised the stiles and rails all the width, proceed to ploughing and sticking, and cut out what is called the haunching after; the method adopted by numbers, of haunching the stiles and rails before you plough or stick them, is a latent notion, invented by some who were fonder of studied maxims, than well-approved methods; if the principal effort to a clean door, lay in the mortise, and tenant, the maxim would be good; but as it depends solely upon the parts before mentioned, it is obvious, that our particular care should turn to these principles; which cannot so well be done to a certainty with the haunching cut out first; besides the inconvenience of spoiling the plain, by knocking the end against the notches.—There are others who pretend to be more sure and wise than the last mentioned, that put their work together square, and plain it off on both sides; then proceed to plough and stick, &c. but those are more intolerable than the other; having not one argument to support it: for if the stuff is reduced irregularly, (which must be the case so done) the moulding must consequently be so on one side, and palpably void of both truth and beauty.

There is another observation in scribing, that may not be amiss to mention, which is the common

error that many young men daily commit for want of thought; that is, the attempt of ſcribing a ſquare or the level fillet of an ovolo on doors, or other framing of this kind: thoſe that have this method, I beg of them to aboliſh it, and conſider the inconſiſtency of mitring two level pieces of equal thickneſs, and to lap one upon another with a ſcribe.

As all framing is founded upon theſe principles, I think it unneceſſary to ſay more of the practice of common work; though it may be requiſite to ſay ſome little of bead and fluſh; after which I ſhall proceed to the value of doors, with ſome remarks of mahogany and wainſcot ditto.

A bead is a moulding which cannot be otherwiſe framed than by a mitre: therefore hath a limit or certain extention, for every rail or muntin; and not like work that is ſcribed together, which may be moved to any length within the circumſcription of the eye.

The beſt method of framing bead and fluſh for learners, is, to mitre his work ſquare, and in this ſtate put in the pannels, and after ſmooth all off together; then take it apart, and ſtick the bead; if the pannels are marked, and put to their places, and the bead well ſtuck, he will be aſſured of making clean work.

Of Mahogany doors.

Mahogany and wainſcot doors differ from common framing of deal, by reaſon of the nicety of the mortiſes and tenons; which require great care, by reaſon that no pins are uſed in theſe ſorts of work, which ſhould be made as ſmooth as if the whole was executed by a plain. The manner of putting together is the ſame as other framing in every reſpect

elſe;

else; except the double margin in the middle, which must always go through the top and bottom rail; also the top and bottom rail be continued, and instead of being mortised, that part where the mortise should be, must be left as a tenant; and the double-margined stile mortised in this place, and slipped on, both at the top and bottom.

The true meaning of this method is more forcibly to shew the effect of folding-doors, which could by no means be done, if this double-margined stile was to be tenanted into the top and bottom rail; and the bead run across the grain of the wood.

A mahogany door well executed, is, perhaps, one of the neatest pieces of workmanship that comes into the hands of joiners. There are many sorts of them; but I speak of the best; such as are worth labour only 10l. or 12l. making; numbers of which are in this metropolis, as well as in many noblemen and gentlemens houses in the country.

As these sort of doors are unknown in some parts of the kingdom, I shall take the liberty to describe one of them. The best sort of mahogany doors are cased, having deal within both stiles and pannels; and are done in the following manner: First, upon the edges of the stiles and rails, glue slips of mahogany, of an inch and quarter each; also round the pannels must be put a margin of ditto, something broader than the raising, neatly mitred at the angles; when they are raised and fineered, a small artragel-moulding is put upon the top of the raising of the pannels; likewise must be cross-banded at both ends, and all the pannels fluted upon the raisings round; the stiles and rails fineered as the pannels: the reason of applying the deal, is, for the advantage of fineering; having more attraction than any other wood.

It

It is almoſt impoſſible to ſtipulate a price for one of thoſe doors, without inſpection, more than the labour; becauſe it chiefly depends upon the value of the fineers; which are from 1s. per foot to 10s. ditto and more; therefore we muſt confine ourſelves ſolely to the labour. A mahogany door, well executed in the above manner, is worth, per foot ſuperficial, to a maſter, labour only, 12l. 10s. 6d. and will take a journeyman near nine weeks work; one of thoſe doors with materials is worth 20l.

To the learner, who is not acquainted with the nature of fineering, I muſt obſerve to him to be particularly careful of his glue: for moſt of the errors that happen in fineering, are cauſed by laying on the glue too thin: glue for mahogany fineers ſhould be at leaſt of treble ſtrength to what is commonly uſed for rubbing of joints; alſo be careful that no water gets under the fineer, and that the iron you heat your work with be not moved to any dry place, but where your glue lodges; keeping ſtill wetting every part where you have occaſion to move it.

There are other mahogany doors, ſome fineered and others ſolid, from 2s. 6d. per foot to the above price.

	s.	d.
Mahogany doors ſolid, and flat pannel, are worth, with materials, per foot,	2	6
Surveyors allow, according as they are in goodneſs, from 2s. to	2	9
Maſters charge ——	3	0

Thoſe that are fineered vary according to the price of thoſe materials, &c.

Wainſcot doors are uſually made with double margins in the middle, raiſed upon the pannel, with

with an aſtragal moulding, and croſs-banded, as mahogany ones.

	s.	d.
Any executed in the above manner are worth, per foot ſuperficial,	3	6
Surveyors allow to ditto	3	6
Maſters ditto — —	4	0
Ditto, with flat pannel, per foot ſuperf.	2	3
The materials to a wainſcot door, raiſed pannels on both ſides, are worth per foot of good Norway oak, glue, &c.	1	4
Ditto, flat pannel, —	0	10

The labour to a wainſcot door, raiſed pannel, double-margined, croſs-banded, and an aſtragal mitred round the top of the raiſing, is about a fortnight's work; ditto, with flat pannel, 6 days; common doors, ovolo, and flat pannel on both ſides, is 2 ¼ days work.

	s.	d.
To a maſter are worth, per foot ſuperficial, with materials, ——	1	4
Some ſurveyors allow —	1	6
Maſters charge ——	1	6
Ditto, with raiſed pannels on both ſides, well done, are worth	1	10
Surveyors allow from 1 s. 7 d. to	2	0
Maſters charge of good ſtuff, well done,	2	0

The labour to one of thoſe doors is four days.

Bead and fluſh doors of deal, 2 inch ſtuff, work on both ſides, is worth per foot ſuperficial, ——	1	4
Surveyors allow from 1 s. to	1	6
Many maſters charge	1	6
Bead and fluſh, 2 inch ſtuff of wainſcot, work on both ſides, ſurveyors allow from 1 s. 9 d. to ——	2	2

Maſters

		s.	d.
Masters charge	——	2	2
The labour to one of those is 6 days.			
Bead and flush doors, on one side, per foot, by masters,	——	0	10
Surveyors allow from 7d. to		0	10
The labour to one of this sort is 1 ¼ day.			
Ditto, ovlo and flat pannel, of whole-deal, work on one side, square back, the masters charge	——	0	10
Surveyors allow from 8d. to		0	10
The materials to whole-deal doors, ovolo and flat pannel, are worth per ft. superf.		0	3½
The labour to one of this sort of doors is 1 ½ day.			
This sort of work, stuck with an o-gee, or any other moulding, the same.			
Whole-deal square-framed doors, and flat pannel, the surveyors allow, per foot single measure, from 5d. to		0	7
Masters charge	—	0	7
The labour to one of those doors is one day's work.			
The materials are worth per foot		0	2½
The universal price should be per foot		0	5½
Whole-deal ledged doors, stuck with a ⅞ o-gee ploughed and tongued, the surveyors allow, per foot superficial, from 8d. to	—— ——	1	0
Masters charge from 10d. to		1	1
The materials to one of those doors, of good yellow deal, nails, &c. are worth per foot superficial,		0	5

The labour to ditto, 1 day ¾; which may be about three-pence per foot more; therefore the universal price should be per ditto 9d. ½.

The

The learner muſt obſerve, that the ledgings or frame of one of theſe doors is mortiſed and tenoned together, and the frame ſo contracted, when nailed on, as to leave a rabbit both on the ſides and the top for a ſtop againſt the door-caſe.

	s.	d.
Whole-deal doors, plain, with a bead upon the edges, and battens nailed upon the back, for warehouſes, &c. ſurveyors allow, per foot of yellow deal, from 5d. ½ to	0	6½
Maſters charge	0	7
The materials to one of thoſe doors are worth, per foot,	0	3½
The labour 1 day's work. The univerſal price ſhould be, per foot,	0	6½
All half-inch batten-doors are worth per foot, ſtuff and labour,	0	3½
Some maſters charge	0	4½
Surveyors allow from 3d. to	0	4½
Large coach-houſe doors, &c. yellow deal, of 2½ inch ſtuff, bead and fluſh in front, and filled with fluſh behind, or framed ſo, the maſters charge per foot	2	0
Surveyors allow from 1s. 6d. to	2	0
The materials to this ſort of work are worth, per foot, —	0	7½
The labour to thoſe doors is worth, per foot, 10d; therefore the univerſal price ſhould be, per foot,	1	8

T LECTURE

LECTURE XXV.

Of Floors.

A FLOOR is the plain area, or ſuperficial content of a room; of theſe there are divers ſorts and qualities, as of Norway oak, clean deal, ſecond beſt ditto, battens of three ſorts, white deals, &c. but the beſt are of oak.

There is nothing very particular in the practice of floors; though it may not be improper to make two or three obſervations: the firſt is, when he prepares his boards to be very careful not to ſhoot the edges too much under; for, if ſo done, they are then ſure to creak, a thing very diſagreeable: the next is, that he be particularly careful, that the joiſts next the walls be directly ſtreight, and that the boards in theſe places (when laid) be of an exact thickneſs, and ſtreight acroſs; for if there are any defects, they are ſooner diſcovered at the ends of the boards than in the middle; beſides, there is the diſadvantage of their remaining ſo, becauſe they cannot ſo well be ſmoothed off.

The next thing is, when you plough and tongue the ends of the heading-joints, lay that tenoned firſt; in ſo doing you will have two-thirds of the board to nail through; if you lay the ploughed one firſt, you have but one-third; beſides, you will have the diſadvantage of making both your joints with a rabbit-plane, which is troubleſome.

The next obſervation is, when you lay a dowel-floor, be ſure to bore for the dowels, and utterly aboliſh the taſk-maſters method of punching the edges; alſo, when you mark them, do not be too anxious in giving too much draught to the pins, for

by

by ſo doing you not only take away the efficacy and ſtrength, but bruiſe, and render the heading-joint more defective than if it was not cloſe at all. With regard to the number of dowels, if the joiſts are no more than 10 inches apart, one between every joiſt will do; if 12 inches, or 13 inches, there muſt be two, and of oak-floors three.

	£.	s.
The maſters charge for dowel-floors of Norway oak, from inch and eighth to inch and quarter ſtuff, per ſquare yard	5	10
Surveyors from 4l. 10s. to	5	5
The materials, dowels, &c. are worth per ſquare yard, of good Norway oak, inch and quarter ſtuff,	3	3
The labour to a ſquare of wainſcot-floor, well done, is ſix days work; therefore the univerſal price ſhould be per ſquare	4	15
Clean deal-floors, clear of ſap, the maſters charge, per ſquare, from 4l. 10s. to	7	0

owing to a particular value they ſometimes ſet on boards of an unuſual length, which they get clean to lay through without any heading-joints.

	£.	s.
I have known a maſter in London charge for particular boards, per ſquare,	10	10

The ſtuff unprepared coſt 11d. per foot; and the maſter had kept it by him ſeven years, to ſerve a particular occaſion.

Surveyors allow for clean-floors of deal, from 3l. 15s. to	4	15
The boards and dowels to a ſquare ſhot, clear of ſap, are worth per ſquare	3	0
Labour to ditto, 4 ½ days; therefore the univerſal price ſhould be	4	15
Second beſt ditto, dowelled, maſters charge — —	4	0
Surveyors from 3l. to	4	0

 The

	£.	s.
The materials are worth per ſquare	2	5
Labour, four days; the univerſal price ſhould be per ſquare	3	15
Common ſtreight joint floors, the maſters charge per ſquare, ſhot clear of ſap,	2	2
Surveyors allow from 1l. 15s. to	2	0
The materials of ſhot clear of ſap, are worth per ſquare —	1	10
Labour to ditto, 2 ½ days; therefore the real value ſhould be per ſquare	1	18
Common folding-doors of white deal, the maſters charge from 1l. 10s. to	1	13
Surveyors allow from 1l. 5s. to	1	13
Good white ſtuff appropriated for floors, is worth per ſquare, whole-deal,	1	5
The labour to ditto, 2 days; therefore the univerſal price ſhould be at leaſt	1	13

Note, the nails and furrings are included in the materials to all the above prices.

The quantity of nails to all floors is as follows: To folding and ſtreight-joint floors, every ſquare will take 250 nails; dowelled ditto, 130.

LECTURE XXVI.

Of GROUNDS *in general.*

GRounds are the level or plain ſurfaces on which all works are fixed, and require but little execution; though it is requiſite all theſe things be noticed in the putting up; becauſe on the juſt and exact form of grounds, depends the conſequence of many material matters; as the hanging of doors, window-

window-ſhutters, &c. as well as fixing of architraves, mouldings, &c.

Grounds to doors muſt always be ploughed in the edge, if not mortiſed to receive dado, if any uſed.

In making grounds to windows, care ſhould be taken that they are not bevelled too much, leſt that ſhould be an impediment to the back-ſhutters; which is very frequently the caſe.

Grounds to windows ſhould be reduced to ¼ of an inch upon the edge, and ſhould not be bevelled more than ¼ more, unleſs the window-ſhutters are in ſpacious buildings, and run from 12 to 16 inches wide; in ſuch caſes there is no difficulty.

Grounds in general are charged by maſters, and allowed by ſurveyors, per foot, from 2d. ½ to 3d. ½; which is a fair price, if grounds to windows are included; if not 2d. ½ ſhould be the price. Grounds to windows ſhould be 3d. double meaſure.

	d.
All grounds to chimnies are charged, by maſters, from 6d. per foot ſuperficial, to	8½
Surveyors allow from 5d. to	8

The materials, to chimney-grounds, with glue and nails, are worth per foot, 4d. labour to ditto, to a maſter, 4d. Therefore the real price ſhould be 8d.

LECTURE XXVII.

Of WINDOW-SHUTTERS.

THERE is nothing particular in the practice of ſhutters, more than what has already been ſaid of other framing of doors, unleſs they are made flat pannel, which is the preſent practice, with an aſtragal moulding mitred round, about the diſtance of

of the ſuppoſed raiſing: what I mean by difficulty here, is to adviſe the learner to be careful to ſecure his pannels, leſt they ſhould caſt, which will cauſe ſome trouble when he comes to put on his mouldings; the beſt method of doing this is to plough ſome pieces the thickneſs of the pannel; and, when you have planed and finiſhed them, put thoſe pieces to the ends, till you have put on the mouldings: this may be done as well after ſhutters or doors are together; but the other is the cleaneſt way, which will appear in practice.

Of hanging of ſhutters.

There is ſome difficulty in the hanging of ſhutters to learners, therefore I ſhall endeavour to be as clear as poſſible in this particular.

If ſhutters are hung double, that is, cut in the middle, they muſt always be hung the whole length firſt, and then taken down and cut; and obſerve, with regard to this laſt particular, that you do not cut the joint by the range of the middle bar, but ſquare from each outward ſtile, till they both meet in the middle; the reaſon of this is obvious. If the ſaſh-frames ſhould incline either way, they would not open, if cut otherwiſe than ſquare.

In order to hang ſhutters at the firſt trial, obſerve the following method: Firſt, ſet off the margin from the bead on both ſides: after prick upon the ſaſh-frame half the thickneſs of the joint of the hinge; then drive in brads at thoſe pricks; to which put the ſhutter, and ſcrew it to; and when opened, will exactly turn to the place required.

Window-ſhutters are but very indifferently paid for; the maſters charge per foot for

front-

	s.	d.
front-ſhutters, ovolo and flat pannel, bead and butt on the back,	1	0
Surveyors allow from 10d. to	1	0
The materials to window-ſhutters, ovolo and flat pannel in front, and fluſh bead behind, is worth per foot ſuperficial, with glue, &c.	0	4
The labour to ditto, hung double, to a maſter is worth per foot 9d. therefore the price of front-ſhutters ſhould be	1	3
Ovolo and flat in front, and ſquare behind, hung ſingle, ſhould be meaſured with the back-flaps and linings; if they are framed, and all reckoned as ſingle work, at per foot ſuperficial, if well done,	1	0

There is no way for either maſters to be paid for their trouble, or gentlemen to have their work well done, unleſs this way of ſettling the matter be adopted. The method by ſurveyors of meaſuring front-ſhutters at value and half, and back-flaps but ſingle meaſure, at the price of 10d. the former, and 7d. the latter, will in no-wiſe pay the labour and half the ſtuff. For ſuppoſing a window of 18 feet,

	s.	d.
the making the ſhutters, fitting in, and hanging ditto, is at leaſt five days work; which we will call only	13	4
The ſtuff, glue, conſidering the diſadvantage of cutting to waſte, is worth, per foot all together, 3d.½; which is	4	11
	18	3

I will ſay, to front-ſhutters 9 feet, at 10d.	7	6
Back-flaps, nine more, at 7d. ditto	5	3
	12	9

We

We find, by the above obſervations, that the labour to making and hanging ſhutters to a window comes to 18s. 4d. and that the price allowed by many ſurveyors is only 12s. 9d. with materials; therefore I will appeal to every ſenſible man, if this matter does not require a better ſtipulation.

Some people may think that five days labour is more than theſe things will take; and ſo it is in ſome men; but we are not, in labour, to judge from the beſt workmen, but take the caſual run in a ſhop: and if ſo, I believe we ſhould find, to a window, well done, but little variation from the time above mentioned. Taſk-maſters, indeed, would do the above work in three days: but work ſo done is of little uſe, when compared to, or placed near, ſomething of the ſame kind from a capital ſhop.

The real price of window-ſhutters ſhould be ſtipulated according to the following example:

	s.	*d.*
Inch and half ſhutters, ſtuck with o-gee or fancy moulding mitred together, flat pannel with moulding round ditto, fluſh and bead, or ſtuck with an ovolo, &c. ſhould be per foot ſingle meaſure	2	0
Ditto, raiſed in front on the pannel, with aſtragal moulding upon it,	2	3
Ditto, fluted upon the raiſing,	3	6
Back ſhutters to ditto, framed bead and fluſh,	1	0
All common window-ſhutters, fronts and back-flaps framed, ſhould be valued all together at per foot ſuperficial, with materials,	1	0
Common ovolo ſhutters, ſquare behind, back flaps plane, per foot all together,	0	10

Theſe prices are as low as any maſter, that does reputable work, can afford, to live by.

LECTURE XXVIII.

Of WAINSCOTTING.

WAinscotting, in this refined age, is quite obselete, and seldom used, except in studies, or offices for servants, &c. therefore shall omit saying any thing of it more than its value.

	s.	d.
Wainscotting with yellow deal, flat pannel, per yard, masters charge from 4 s. 6 d. to	5	0
Surveyors allow from 3 s. 9 d. to	4	6
The materials, whole-deal, and ¾ pannels, are worth per yard, glue, nails, putting up, &c.	2	6
The neat labour to a yard of wainscot is, on the nearest calculation, valued at 1 s. 2 d. therefore the universal price should be at least	4	0
Square wainscot, whole white-deal pannels, of ⅝ stuff, masters charge from 3 s. to	3	6
The surveyors allow from 2 s. 10 d. to	3	3
The materials to a yard of white deal, square wainscotting, is worth	2	0
Neat labour to ditto, 11 d. ½; the general price should be per yard	3	3
2 inch partitions, square, and flat on both sides, masters charge per yard	4	6
Surveyors allow per yard from 4 s. to	4	6
The materials to a yard of this sort of work are worth, per ditto, about	2	6
The labour to ditto, at the nearest calculation, a master must pay, is, 1 s. 6 d. therefore the universal price cannot be less than	4	6

	s.	d.
Square wainſcot, framed fluſh for hanging canvas againſt, for paper, &c. the maſters charge	2	9
Surveyors allow from 2s. 4d. to	2	8
The materials to a yard of this are worth	1	6
Neat labour to ditto 1s. therefore the univerſal price of this ſort of work ſhould be	2	9

Of backs and elbows.

Theſe are a good invention of wainſcotting, appropriated to the back and elbows of windows, and framed after the manner of the ſhutters, which make not only the windows of one connected form, but alſo give more room, by the advantage of the projection of all the baſe and ſur-baſe mouldings, which ſtop againſt the archatraves, and in this caſe go down to the floor, or finiſh upon a ſquare plinth the height of the ſkirting.

	d.
This ſort of work is but poorly paid for; the price by maſters is, per foot	6½
Surveyors allow from 5d. to	6½
The labour to one foot of this work is 3d. neat; materials are worth, per foot, ovolo and flat, 3d. ½; therefore the univerſal price to maſters ſhould be 7d. ½, or	8

LECTURE XXIX.

Of Sash-Frames *and* Sashes.

Saſh-frames are a part of the buſineſs eaſily underſtood, and require but little merit in the execution; the principal care ſhould lie in the dividing the pulley-piece, ſo that there be room for the ſaſhes to move; obſerve alſo, that if your ſaſhes are to

to be hung with iron weights, that the pulley-block be put within 3 inches of the top; elſe if your frame is ſhort you will not have room, on account of the length of the weights. Obſerve, with regard to the inſide linings, that they are not leſs in width than 4 $\frac{1}{2}$ inches. By ſo doing you will oftentimes prevent a great deal of unneceſſary trouble in hanging the back-ſhutters, and alſo have ſufficient room for bars, &c.

Saſhes, well made, require good execution, and ſhould always be put into the hands of men of merit and experience, by reaſon they are a part of the branch that is ever oppoſed to the eye, therefore ſhould be made particularly clean; eſpecially that ſort which is ſtuck with an aſtragal and hollow.

There are many particulars to a well-made ſaſh which the learner muſt be apprized of; firſt, the planing up the ſtuff; ſecondly, the ſetting out; thirdly, the mortiſing; fourthly, the filliſtring, and ſticking the moulding; and, fifthly, the great principle or maſter-ſtroke, which is the wedging up; for on this depends the beauty, or real effect.

The learner muſt underſtand that the chief merit of a ſaſh is attributed to the ſtreightneſs of the bars, and ſuperficies, which may be totally diſconcerted by an unneceſſary blow at one ſingle wedge, though the whole work to it beſide is ever ſo well done; therefore great care ſhould be taken of this matter, as well as the forementioned obſervations.

There are many ways of putting an aſtragal ſaſh together; the beſt method is to mitre the whole moulding, not through into the mortiſe, but a little lower than the face of the moulding, on both ſides, to the extreme point at the top.

The rail or bar that is tenonted muſt be mitred, as if for ſcribing; and then cut under with a ſaw,

from the point to the tenant. Obſerve, in dowling ſaſhes, that the dowles be not ſhorter than four inches.

	s.	d.
Saſhes and frames are generally valued together, from 1s. 2d. per foot to	2	0
Saſh-frames with oak-ſoils, pulley-pieces and outſide linings of ditto, inſide ditto of deal, the maſters charge, with aſtragal ſaſhes of good Norway oak, from 1s. 6d. to	2	0
Surveyors allow from 1s. 4d. to	2	0
The materials of ſaſh and frames together, to the above particular, are worth per foot	0	7
Neat labour to ditto, the ſaſh hung double, is about — —	0	6
Therefore the real or univerſal price ſhould be per foot together	1	4
Aſtragal ſaſhes alone are worth per foot, with materials, and well made,	0	9
Ditto, ſtuck with an ovolo,	0	7
The maſters charge for the former	1	0
The latter from 10d. to	0	11
Saſh-frames, with oak pulley-pieces and ſoils, the out and inſide linings deal, the head fineered, and oak ſaſhes, ſtuck with an ovolo, the maſters charge	1	9
Surveyors allow from 1s. 3d. to	1	8
The materials are worth per foot	0	6
The labour —	0	5
Therefore the price ſhould be	1	3
Deal ſaſh-frames and ſaſhes the maſters charge per foot —	1	0
Surveyors allow from 7d. to	1	0
The materials are worth per foot	0	4
The neat labour 3d. ½; therefore the genuine price ſhould be per foot	0	10

Deal

	s.	d.
Deal ſaſhes alone are worth per foot to a maſter — —	0	5
Saſhes to fronts of ſhops, of mahogany, ſtuck with an aſtragal and hollow, to a maſter are worth per foot ſuperficial	1	0
Maſters charge from 1s. to	1	3
Surveyors allow from 10d. to	1	0
The materials to mahogany ſaſhes are worth per foot —	0	6
Ditto, all ſhop-fronts that are made out of the common method, as octagon, figures, &c. are worth per foot	1	8
The neat labour to ditto	1	11

Circular figures double meaſure.

Ditto, of wainſcot or deal, the ſame as common ſaſhes, to a double price.

LECTURE XXX.

Of DOMICAL SKY-LIGHTS.

A Domical ſky-light is a part of the branch that requires a great deal of practice, or at leaſt if it is put into the hands of a perſon unacquainted with its principles, he ſhould be a tolerable adept in other particulars of practice, as well as having a profound knowledge of lines, not that there is any thing very extraordinary belonging to it, more than other circular work; after the conſequence of the weather is guarded againſt, which muſt be maturely conſidered before he cuts one piece of ſtuff.

The beſt method of doing this piece of work, in my opinion, is to make ſtiles of the upright ribs, (though it is not a common rule) having by this

a better

a better opportunity of rabbiting the rails, which muſt be done for the upper end of every pane of glaſs, ſo that the pane above ſhall reach over $\frac{3}{4}$ of an inch, for the clearer effect of diſcharging the water. The mode of making a ſkylight, in point of workmanſhip, is to make them exactly domical within, and ſtick them as another ſaſh, making the ſtuff no thicker at the bottom than the top; the outſide (for my own part) I would always make ſtreight with the glaſs both ways, and cut the ſtiles out in notches, which will appear like ſtripes one above another, as the dome naturally riſes: if the plan is an exact circle, and hath a concentric crown, one templet will do for all the ſtiles.

The way to get the ſize of all the rails, to every different ſweep, as the dome diminiſhes to the crown, is, firſt, draw the ſize of two ribs, with the outſide marked to the glaſs; and on thoſe ribs ſet out the ſection of all the rails; from which draw perpendiculars into the ground-plan, which will give you the exact ſize of every circle to the crown; to every one of thoſe it may not be amiſs to make moulds, which will more pertinently point to the learner the length of the rails, becauſe upon each mold, and at every ſtile he can ſet out the exact ſize of the ſtuff, and be more ſure of his lengths: when theſe things are once got, he may proceed with the ſame accuracy as in other circular works.

	s.	d.
The value of a domical ſky-light, if meaſured ſingle, is worth to a maſter per foot	5	6
Materials to ditto, of wainſcot, per foot	2	0
Of deal — — —	1	8

Saſh-makers can afford them conſiderably cheaper.

LECTURE

LECTURE XXXI.

Of STAIR-CASING.

OF all things to be conſidered in a building, there is nothing ſo material as ſtairs, nor any thing that requires half the abilities, either to plan or execute, and may juſtly be called the maſter-piece of accommodation in every edifice; for, on a proper diſpoſition, or diſpoſal of ſtairs, depends (in a great meaſure) not only the ſtrength and beauty, but the chief eaſe and deportment of the whole ſtructure.

A whole volume might be written upon this ſubject, and, when done, ſo various and extenſive the manner, as well as mode of execution, that this ſo eſſential a point muſt unavoidably be left to the builder's judgment at laſt, without it were poſſible to define every plan and ſituation that could in any wiſe happen; a thing totally beyond the power of art. However, it will not depreciate the judgment of any architect, to give this point a particular thought, before one ſtone or brick is laid; and not (as many do) leave an article ſo material to the whole, to be jumbled up without either grace or freedom.

Many people are of opinion, that there is no difficulty in ſtairs, provided there be room enough. I muſt allow, that to the workman it is much eaſier, when the place aſſigned is ſpacious, the ſtories high, and entirely void of impediment; but, at the ſame time, I muſt alſo obſerve, that it will require a maſterly thought in the architect, to allow ſuch a vacuum or opening, without endangering the ſtrength of the ſtructure; this particular muſt be maturely

maturely confidered, and not for the fake of this neceffary part facrifice the confequence of the whole building: notwithftanding, it would be (on the other hand) the height of imprudence, to conftruct, or defign, any infufficient or inelegant to the purpofe; and in order to avoid one error, plunge into fimilar abfurdities; it is therefore upon thefe principles that our judgment fhould operate; ftudying firft their intent, properties, and convenience; the nature of the building will pertinently point out the mode of execution, and what will be adequate to the reft of the works propofed; the whole of which, more than the executive part, muft depend, and that folely, upon the builder, or furveyor's judgment.

Several rules and precepts might be laid down, concerning the form, as well as the management of ftairs, fuch as to have a liberal light againft all cafualties of flips and falls; that head-way, or fpace above, in every refpect be free and lofty; that half paces be judicioufly diftributed, and at competent diftances; that the breadth of fteps be never more than feventeen inches, or lefs than eleven inches; and, that they exceed not by any means feven inches in height, in order to prevent our legs from labouring more in elevation than diftinction; that to prevent encounters by the way of paffing, ftairs fhould never be lefs in latitude than four feet fix-inches; and many more of the like obfervations might be alluded to, though they cannot be ftrictly adhered with, for this fpecial reafon, becaufe every fituation of ftairs is tied down to the rules of difcretion, and under the neceffity of providing againft their own inconveniences.

Though it may not be amifs, for every furveyor or builder, in the firft defigning of a houfe, to confider

ſider the nature of the work itſelf; what ſort of ſtairs have the beſt effect, both in form, and when executed; he perhaps might avoid in ſome meaſure thoſe technical contracted plans, which are treble the expence of elegant ſtairs, and which often deſtroy that gracefulneſs which ſhould conſiſt in an analogy, or correſpondence, with the beauty of the whole building.

It is from the forementioned obſervations, that the principles of ſtairs will ever be a matter of the firſt conſequence in every age and to every ſtudent; for without it were poſſible to communicate wiſdom, ſome people would not be benefitted by a volume written upon the ſubject of planning ſtairs.

There are many more obſervations, touching the practice of ſtairs, which I ſhall treat of as they may occur to my memory; omitting nothing that may conduce to the benefit of mankind, to whom I humbly dedicate my endeavours.

Though there is as great a variety of forms of ſtairs, as there are ſituations; yet their principles of practice are generally reduced to three, viz. geometry, bracket ditto, and what are called dog-legged ſtairs.

Geometry ſtairs are of that conſtruction which ſeem, to the illiberal and vulgar, to have no ſupport for the ſteps, having neither carriages, or leading-pieces to bear them; the properties of which I ſhall hereafter define.

Bracket ditto, are ſuch as have ſtrings and newels, and are ſupported by carriages and leading-pieces of timber; the bracket of which is mitred to the end of the riſer of the ſtep, and finiſhes upon the ſtring-board, which is moulded like an architrave, &c.

What are called dog-legged ſtairs, are ſuch as have no vacuum or ſpace between the leading or returning flight, but wind round one newel to the top; theſe, if there is room, have alſo leading-pieces for their ſupport; if not, are ſometimes fixed into ſtrings on both ſides, and put to the bearers for the winders.

LECTURE XXXII.

Of the PRACTICE *of* STAIRS.

BEFORE I begin to define the practice of ſtairs, I beg my reader to diveſt himſelf of all ſuperfluous notions, ſuch as unconnected lines laid down by many architects, as well as the ſtudied maxims practiſed by numbers, and follow the ſenſe of his own reaſon, cloſe by the inſtructions I ſhall point out, and I make not the leaſt doubt, but he will (after he has maturely weighed the practical methods I ſhall allude to) be capable of executing any thing that may occur in the courſe of the whole.

If he is totally unacquainted with this matter, I muſt intreat of him, (if it may not be convenient to take my inſtructions to his bench) to ſtudy them till he can rote them by heart; by ſo doing, he will have the advantage of purſuing his work without let or moleſtation.

LECTURE

LECTURE XXXIII.

Of the Practice of Dog-legged Stairs.

THE elevation of dog-legged stairs depends solely upon the nature of the size of the place they are to be fixed in, as length and width of the plan, as well as the heights of the different stories; but the chief article to be considered is the height; for let your plan as to length be ever so short, you must have a sufficient tread for the steps; therefore the advantage for getting up must be taken in the half space, which may be divided into any number of winders required; for the better understanding of which, mark the following examples.

First, Upon a board, make a scale the size of the ground plan, viz. the length and width; in the middle of the width set out the newels; this done, you will have the length of the steps.

2dly, Divide your length to the half-space for the number of streight fliers, both going to the half-pace, and returning from it, to the first story; and leave the half-pace till you have divided your height.

3dly, By the side of the ground-plan continue up your newels; and, having divided the height into the nearest number of steps you can have, count the number of streight fliers, both going and returning; the remains, to make up the height of the story, must be had in the half-pace, equally divided.

4thly, Continue the lines of the width of the steps upon the plan of the first streight flight, and likewise meet them from the different heights marked upon the newel, which will form the section of the

the ends of the ſteps; after, to the treads, ſet on the projection of the noſings, and with a ſtreight edge, draw a line cloſe to them, which will be the upper-edge of the ſtring; then ſet out the width of the ſtring, allowing for the thickneſs of leading-pieces, laths, and plaiſter, &c. After draw the ſide of the rail parallel to the ſtring, two feet wide upon the ſquare, with knee, &c. if there is one, which will complete the geometrical ſection of the firſt flight.

5thly, Count the number of winders in the half-pace; at the top of which draw a baſe line, equal to the length of your returning flight; which may, perhaps, conſiſt of one or two leſs than the firſt flight, as may be convenient for the advantage of the landing; then proceed with drawing the ſection in every reſpect as before.

The uſe of drawing the ſection of ſtairs is only to give the learner a clearer light into the nature of ſetting out his newels for mortiſing, which may be done equally as well by ſetting out the height and width upon a rod: but this is only to be done by people who have had ſome practice, or at leaſt are in poſſeſſion of fertile ideas.

When you only uſe a rod without drawing the ſection, as before obſerved, count the height of the ſteps in the firſt ſtreight flight; from which ſet out the width of the mortiſe downwards; next ſet out the height of the winders, and the firſt ſtep of the returning flight, with the rake of the noſings, which will give you the top of the mortiſe for the returning flight; and proceed with the reſt as before.

The learner muſt obſerve, with regard to fixing his middle newel, that the noſing of the firſt winder be exactly fluſh with the inſide newel, that the whole thickneſs may be into the half-pace; alſo on the

the returning flight, that the nosing of the first streight flier be flush with the outside of ditto into the half-pace: and this order must be followed with respect to newels in all stairs whatsoever.

LECTURE XXXIV.

Of setting out a Newel for Turning.

THE way to make a proper limit for the bottom of the turning, is to take the rake of the steps nosings, allowing thickness of the capping; and where that falls upon the inside of the newel, is the mark for turning: the newel of the returning flight must have the addition of one step in height, and then the rake of the pitch-board, or nosings, as before observed.

LECTURE XXXV.

Of setting out a cap, and mitring ditto square, before it is sent to the turner's.

FIRST, draw the width of the hand-rail, and add to this the projection of the mouldings on both sides, for the outward diameter of the cap; to which draw a circle: then set within this circle the projection of the mouldings transferred from the streight rail, and draw inner circles to the different members; and also from the streight rail draw the same lines of projection into those circles; and where they intersect, will be the points for the mitring the cap, drawn by a streight edge to the point, through different intersections; then cut out the piece neatly, stick it in again with glue, and send it to the turner's.

LECTURE

LECTURE XXXVI.

Of BRACKET-STAIRS.

BRacket-ſtairs differ nothing from what has been already defined of dog-legged ditto, with regard to newels and ſtrings; only thoſe have a well-hole between the leading and returning flight; ſome ſquare others circular or oval; and, inſtead of the ends of the ſteps fitting to the ſtring-board, (as before obſerved) the ſtrings are cut for the reception of the ſteps; not through any motive of ſtrength or bearing, but ornament, that the bracket may be fixed, and mitred to the end of each riſer, againſt the ſtring, with the noſings of the ſteps continued round, which covers the joint of the bracket to the end of the ſtep, and which hath a beautiful effect when well executed.

The ſame method, with regard to drawing the ſection of ſtairs, as before obſerved, I would ſtill propoſe to learners in every reſpect, both for ſtrings and rails, as well as ramps and ſcrolls, which will anſwer every point, both with reſpect to knees, balluſters, &c.

There is no difficulty in theſe ſtairs more than the clean execution; balluſters exactly dove-tailed into the ends of the ſteps, within the noſings properly divided; the riſers all glued to the covers, with backing-pieces glued on the inſide of the ſtep; and, when put up, the underſide of the ſtep nailed or ſcrewed into the under-edge of the riſer; and, when finiſhed, put on the brackets of ſtrength under the ſteps, well nailed to each leading-piece.

Thoſe that are unacquainted with the method of gluing riſers to ſteps, I muſt inform them, that the beſt

best method is to make a frame, or templet, to fix them in, with a place cut out for the projection of the nosing; after glue on the hollow under the nosing, and work them when together.

I hope my reader will understand what I mean by a templet: it is only fixing two upright pieces in any thing, with notches cut out of each, the exact projection of the nosings, to which put the front-edge of the step, and then glue the riser to the cover close to the above pieces, &c.

LECTURE XXXVII.

Of GEOMETRY-STAIRS.

THE practice of geometry-stairs, which hath ever been considered as a master-piece of art, is founded upon as great a principle of strength, as is requisite for the consequence of the invention; which is only to carry a certain weight, or vibrating ponderosity, in any case inferior to the power that doth sustain it.

In order to prove this, we have only to measure the length of the step, and weight of ditto and riser, added to what we propose to go into the wall; then measure in the nature of continued quantity, as I have already defined in the lecture of the leaver; similar to the following example.

The power that doth equi-ponderate with any weight, must have the same proportion unto it, as there is between their several distances: therefore if a step be 4 feet long clear, and six inches into the wall, the weight upon the end in the wall must be as eight to one.

Suppose we say the weight of the step and riser, with the weight of a man, which we will call 20 stone;

ſtone; that multiplied by 8 gives 20 hundred, for the power to ſuſtain a man upon the end of one ſtep naked in the wall; but we muſt conſider that three fourths of this weight will be taken off by the ſupport of the under-ſtep; therefore if we divide 20 by 4, we ſhall find, that 5 cwt. or 70lb. placed upon the end of every ſtep looſe in the wall, will be ſufficient to carry the weight of any man, without either wedge or nail; provided any thing is placed to keep the ſteps in their proper poſition; but what is this trifle in compariſon to the preſſure of a wedge, and the weight of a wall, or truſſing of a partition? which, with interſtices properly framed, will be adequate for the conſequence of any ſtairs thus conſtructed.

My reader muſt obſerve, with regard to ſteps of longer bearings than 4 feet, it will be neceſſary to augment the thickneſs of the covers, according to the following proportion.

All ſteps of four feet clear ſhould not be thinner than 1 $\frac{1}{8}$ inch ſtuff; and for every ſix inches more of length, one-eight more ſhould be added to the thickneſs; alſo that geometry-ſteps go into the wall one tenth part of their length.

There are a kind of geometry-ſtairs that wind round a column or pillar, whoſe bearing or certain gravity tends to one center; thoſe muſt be a little mortiſed into the pillar, the riſer about an inch, and the tread as much as the ſquare of the end of the cover will require, to be juſt clear at the points.

Theſe ſorts of ſtairs are moſt frequently uſed for pulpits, &c. and would almoſt hang with the common ſupport at the top and bottom; however, the additional bearings into the pillar are of great ſervice.

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The method of putting thoſe ſteps together, if they are clean worked on the under-ſide, is to dove-tail the riſers into the cover: and when put up, ſcrew the ſtep to the under-edges of the riſers all the way up; after fit in pieces of wood, neatly matched, in the holes made by the ſcrews; the brackets are mitred to the riſer, and the noſing of the ſtep continued round. This is much the cheapeſt way of doing geometry-ſtairs; but there is a great defect of weakneſs in the brackets hanging in the above manner, looſe as it were, having nothing to ſupport them from every caſualty; and yet to me the ancient method of moulding the ſteps underneath, in the form of the bracket, is heavy, unnatural, and very expenſive, eſpecially to winders.

There is another method by ſome made uſe of, which is putting up blocks, and ſcrewing them well together; and after covering them with riſer and tread, inſtead of brackets, frame the under-ſide of them, ſo that each ſtep appears as ſolid: theſe ſort have not a bad effect, were it not that the expence is ſo very extravagant.

The beſt and ſimpleſt method of doing geometry-ſtairs, is, to put up a ſtring as in others; mitre the bracket to the riſer, and finiſh to the ſtring; then lath and plaiſter underneath, and finiſh with light belexion mouldings of plaiſter; and if the building is elegantly finiſhed, it may not be amiſs to introduce a light ornament in baſſo relievo.

It may be neceſſary to obſerve, that the riſers of 2 inch ſtuff, to geometry-ſtairs of this ſort, would greatly add to their ſolidity.

I think it needleſs to ſay any thing more relative to the properties or practice of ſtairs, ſince the forementioned hints, with a little experience, muſt be ſufficient for a very ordinary capacity; therefore

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ſhall inſtantly proceed with my remarks on the nature of hand-rails, &c.

LECTURE XXXVIII.

Of Hand-rails *to* Stairs.

THE manner of gluing up a twiſt to a ſcroll of a hand-rail, hath ever been (by workmen) eſteemed a maſter-piece of the branch, and is conſidered by numbers as an incomparable piece of art; therefore in order to render this piece of practice as ſuitable as poſſible to the different capacities of workmen in general, I ſhall be as circumſpect as the ſubject will allow, through an earneſt deſire that no man ſhall lack any thing in my power to communicate.

The firſt thing the learner ſhould conſider, is the nature of a ſcroll; its extent, and the cauſe of the twiſt. Theſe things once underſtood, the practice of it will be obvious, and rendered very familiar. Whoever the firſt inventor of a ſcroll to a hand-rail was, I will affirm, that he was a man of enlarged ideas; and, though the invention be rather inadequate to an elegant ſtructure, and inferior to ſomething which might be propoſed for the purpoſe, it is, notwithſtanding, judiciouſly contrived, and hath an eaſe in its mode of finiſhing, that will ever render it an object of notice in every age.

A ſcroll is the perephery or circumference of a a number of circles in a declining ſtate, each leſs than another; therefore to draw this, is no more than to find out the centers, from whence lines laid down to various points, ſhall have given differences; which once found, will always be the centers

ters required to form the volute; and may be in number at the diſcretion of the workman, or as the ſize of the plan may require, either extended or contracted.

The cauſe of the twiſt is the geometrical elevation of the hypothenuſe of a right-angled triangle, and muſt of courſe turn up when moved from its direct line of elevation; and will be more or leſs according to the height or raking-line of the pitch-board, the pitch-board being the right-angled triangle above-mentioned, which is made from the height and width of the ſtep; and, being cut diagonally, gives the hypothenuſe or rake of the rail.

The intent and nature of a ſcroll, is to finiſh upon a level the raking of the rail; which, if not brought to this concluſion, muſt either be ended in a newel, or would finiſh on the ground; becauſe every raking-line hath an intent or tendency to a point of reſt; therefore, in this caſe of a hand-rail, it is wittingly ſtopped in its courſe, and brought to the above judicious concluſion: ſo that in the ſimple practice of this, the learner has nothing to conſider but the height he hath to riſe, which is one ſtep, from the level part of the eye to the height of the pitch-board, which will directly meet the raking of the ſtreight rail, and muſt be effected with an eaſy decline, in the natural winding ſtate, to the very edge of the ſcroll.

To the gluing this up there are three principal things to be conſidered:

The firſt is the matching or appropriating the ſtuff, ſo as the ſtreight rail and grain of the twiſt ſhall unite, and appear as if cut out of one intire piece of timber.

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The ſecond thing to be conſidered, is the ſituation of the raking part, and how much is added or augmented to it by the elevation, which bears the ſame proportion as a raking-moulding to a level one.

The third and laſt conſideration is the falling of the twiſt from the ſtreight rail to the eye of the ſcroll, which muſt be done in ſuch a manner that it ſhall appear with eaſe and beauty.

People who have had practice in gluing up hand-rails, muſt have acquired every tenet relative to it, and have no occaſion to gather the leaſt inſtructions that may or can be propoſed by any author. To ſolve this particular for practice, is the great ſource of this article to thoſe who have not; I will therefore propoſe the ſimpleſt method in art and nature, in order to form a proper conception ſuitable to the weakeſt capacity.

LECTURE XXXIX.

A Definition of Gluing-up HAND-RAILS *without Lines.*

SUppoſing a man had a thing of this ſort to do in a remote part of the kingdom, where there was not an architect-book in poſſeſſion of either the maſter or himſelf, and the whole idea they can form of this matter, is, that upon the firſt ſtep the hand-rail turns round to an eye or cap of a newel, and forms a ſcroll; to ſuch a perſon I propoſe the following method:

After he has put up the ſteps, and cut out the firſt by his eye to the beſt appearance he can, let him plane up the ſtreight part of the hand-rail, and lay it down upon the noſings of the ſteps: ſecondly, let

let him alſo cut by his eye a mould to the ſize he propoſes his hand-rail, obſerving to give the eaſieſt turn to the rail he can; not abridging the ſweeps, but bring it down within two inches of the front of the ſtep, and turn it round to the eye, after the beſt manner he is able: thirdly, let him cut by this mould a piece or block for the eye thicker than the depth of the ſide of the rail, by ſo much as the thickneſs of the pitch-board is, from the baſe line to the rake, two inches from the firſt point; which will be as much as the rail hath to fall, from the ſquare of the twiſt to the eye: fourthly, let him get out one or two pieces to make out the width of the twiſt, and glue them againſt the ſide of the ſtreight rail, and to this block, which will make the whole; obſerving that theſe pieces, which make the twiſt, are to be cut with the pitch-boards raking-line; which, when glued, or proffered to, will be anſwerable to the block and ſtreight rail, and alſo give the riſe of the twiſt.

When theſe pieces are held againſt the rail, the learner will find, that he will want wood upon the top-ſide of the ſtreight rail, and the under-ſide likewiſe; theſe muſt be glued on, or left upon the ſtreight rail ſolid before it is planed up; I ſay, if he glues the pieces on, and cuts the outſide of the rail by his eye, as near as he can, ſquare from the ground-plan, and from the outſide ſquares the top of the rail, and gauges the width and thickneſs, from theſe two ſides, neatly cut by his eye, I propound this method will do; and, if the man hath a good eye, will have a pretty effect without ever a line.

Though ſome adepts in the practice of hand-rails would laugh at ſuch a method, I beg leave to tell them, that I have laid down the lines to ſeveral people,

people, and ſhewed them their properties, yet have not been able to make them underſtand, without having recourſe to ſome ſimilar practices of this kind; not that I propoſe this ſcheme to men that have either ſeen, or have the leaſt conception of ſtairs, or hand-rails; but to learners that have had no practice, and who may not have the leaſt idea of it.

To people who have a knowledge of buſineſs, there are other conſiderations: Firſt, the raking-mould, which muſt be made adequate to the length and width of the twiſted part when held upon the rake, and perpendicular to the ground-plan; likewiſe the mould for the back or fall of the twiſt, from the ſtreight part to the level part of the eye, both outſide and inſide.

Many people uſe no mould for the inſide of the rail, but make the top or back of the rail ſquare from the outſide. But this method is not ſo well; for if it is done ſo, when you mould the rail, the fall from the ſtreight part will be too rapid, and will cauſe a ſort of lameneſs.

The next method, or thing to be thought of, is the ſquaring of the pieces before they are glued on, which may be eaſily done, and is a common practice; and when they are glued on, to be finiſhed and moulded, one joint is left open to be broke, for the better convenience of working the ſcroll.

The way to find the raking-mould for the curve or turn of the twiſted part of the hand-rail, is, firſt to draw the ground-plan of the rail, and thereon repreſent the pieces which are to make the ſcroll, or twiſted part of the rail; upon the ground draw the width of the firſt ſtep; then laying the pitch-board down flat upon the plan of the firſt ſtep, the baſe of the pitch-board againſt the rail, draw the width

width of the rail into the raking part of the pitch-board, which will give the width of the end: likewiſe draw the height of the turn of the twiſt through the pitch-board, and ſquare from the raking-line; and draw different lines from the plan drawn through the raking part, and take off the ſeveral diſtances with your dividers, from the baſe of the pitch-board to the plan, and transfer them from thence to the raking part, in the manner of an angle-bracket; and you will have the raking mould required.

But things of this ſort are much better underſtood by lines, or inſpection, than deſcription; therefore I would in caſes of this ſort, as well as the manner of drawing a ſcroll, refer my reader to thoſe things drawn, with their manner of performance, as ſhewn by architects.

Obſerve, if you make uſe of a raking-mould, (though many do without) you muſt make it of paſteboard, in order that it may bend to the declivity of the rail; elſe you cannot ſo well mark the top of the rail by it. By the raking-mould your pieces muſt be cut for the turn and width of the rail; the mould for the fall of the twiſt, and regular curve for the top of the rail, is done in the following manner.

Upon the ground-plan, where your twiſt begins upon the ſtreight rail, divide the outward curve-line into any number of parts, and transfer them upon a ſtreight line; at the end of which place the pitch-board, which you will underſtand is the height you have to riſe; then divide the raking-line of the pitch-board into any number of parts, and likewiſe the remainder of the ſtreight line, from whence you began the firſt part you transferred from the plan; and after draw interſections of ſtreight lines, which will exactly give the curve of the under-ſide of the rail; then ſet up the depth of the ſide of the rail pa-

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rallel to this, and you will have the curve of the whole twiſt ſtretched out; with this mould you muſt cut your pieces both at the top and bottom; alſo the ſtreight part of the rail that begins to turn up, right away to the level of the eye, and your work will be properly ſquared before it is put together; obſerve in the gluing of them, that you do not ſet them twiſting one to another, and likewiſe perpendicular to the plan.

LECTURE XL.

The Method of drawing a Scroll.

THE method of drawing a ſcroll is to form a circle equal to the width of two ſteps, divided into eight parts: from the center draw a leſſer circle, for the ſize of the eye, larger than the width of the rail by the addition of the mouldings, as a cap to a newel: from the firſt draw a tranverſe diameter, and through the center again draw a conjugate one; then from the outſide of the inner circle, to the large one of two ſteps, divide the upper part of the conjugal diameter into eight parts, for the diminiſhing ſcale; from the outward circle, upon the laſt mentioned diameter, draw a line to the outſide of the ſtreight rail to the point of the tranſverſe diameter, ſet the other point of your dividers, and deſcribe a ſweep to the diagonal line, which will be the width of the ſcale; the eight parts drawn through this, to the point of the diameter at the outſide of the rail, will give the different parts; all to be ſet upon the diameters, or eight parts, as they follow of courſe; when ſo much is done ſet your divider from the center of the eye, to the outward part of the circle, and move it to the firſt eighth part,

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next the ſtreight rail; and make a mark in the eye, and likewiſe from the diameter, or a little above upon the ſtreight rail, ſet your point, and find the mark in the eye laſt made, which will be the center for the firſt eighth-part; then proceed with the ſecond; and ſo on to the eye. If this is not plain enough, I muſt refer you to the drawing of a ſcroll.

Obſerve, that there is no neceſſity, to make a ſcroll equal to two ſteps, nor follow the manner I have ſaid of the ſize of the eye; either of which may be made larger or leſs, as fancy moves the artiſt; only conſider the ſize you make the outward circle, and from that to the inner one; divide the ſcale into any number of parts you chooſe to diminiſh by, and draw, or divide the greater circle into the like; proceed as before; ſometimes a ſcroll is made equal to a ſtep and a half; ſometimes but one ſtep; and ſometimes but a quarter of a revolution; according to the taſte of the ſurveyor or builder.

LECTURE XLI.

Of RAMPS.

A Ramp is a portion of a circle; the center of it is formed by a ſquare line drawn from the rake of the rail, and likewiſe the level of the knee at the top of the half pace continued to this line, gives the center for drawing the curve of the ramp, which is in height the riſe of two ſteps; ſometimes ramps riſe three or four ſteps, in particular caſes, where there are winders; but thoſe have a bad effect, owing to the upper part of the ramp having almoſt no curve.

Ramps, if poſſible, ſhould be cut out of the ſame plank with the ſtreight rail; in the laſt mentioned caſe, the ramp muſt be glued on to the ſtreight rail.

LECTURE XLII.

Of gluing up Hand-rails to circular Plans.

THE many various forms and modes of diſpoſing, to the beſt advantage, a decripped or bad concerted plan for ſtairs, often draws a fertile genius to wreſtle with inconveniences more deſtructive to his tranquility, than matters apparently of much more conſequence.

Stair-caſing may juſtly be called an art of peculiar tendency, becauſe the more labour is ſpent in the execution of its particular parts, the more it is ſubjected to bad cauſes and ill effects, from the very motives that ſhould add grace and freedom to the nature of it, which is in the manner of the hand-rail, and can never by any ſcheme be made pleaſing if ſtretched into any irregular form, as upon plans that conſiſt of a compound or mixture of ſteps, that is, winders and fliers.

Stairs of this ſort cannot, by any power in wiſdom and nature, be made to have either a pleaſing or a good appearance; notwithſtanding it will not be poſſible always to avoid them.

It is greatly to be lamented, that the difficulty required to execute all irregular plans to ſtairs, ſhould not make ſurveyors more careful in the diſpoſing of them, ſince they have not one good quality either in circumſtance or mode to recommend them; and yet ſo infatuated are the builders of this

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age to things of this sort, that we scarcely see one good building, but what is merely contrived for a pile of these unnatural productions.

However, since they are alone the taste of the times, it is fit we should endeavour to point out the most simple and judicious method for executing their hand-rails.

There are many ways of gluing up a hand-rail to a circular, oval, or eleptical plan; but the best, in my opinion, if you have but little ground or opening, is, to do it in thicknesses after the following manner; first, glue up a cilinder of a plank to the size of the well-hole, and having rounded it to fit the plan, draw upon it the section of the ends of the steps.

If it is an entire circular plan, a streight edge will touch all the nosings, and the rail will be in a proper natural rising position; but if you have any streight fliers before the winders, the same after to finish the story; the rail, instead of retaining its natural figure, will, through its own inconveniences, be transformed to the shape and almost figure of an S; for the learner must observe in hand-rails of this sort, there is obliged to be given an additional length to the banisters, in the circular part upon the winders, in order to remedy the defect, which is caused by the sudden elevation of the steps; and for want of distension, or breadth of covers, throws us above our natural position, in either ascending or descending, and obliges us, for the benefit of having hold of the rail, to have recourse to the above experiment; if not so, we should be in danger of falling over the rail in the above-mentioned part; therefore, that very place which should in reason (to cause a pleasing appearance

in the rail) be lowest, is for the motive above-mentioued unavoidably and indispensibly confined to be the highest.

There are some necessary observations relative to the practice of these rails; the first is, the consideration of the matching of the stuff, which must be contrived and cut out of one intire piece of timber, and the fineers all appropriated in the same places they are cut off, in regular succession; and observe, that in the getting this timber cut, that you maturely study the size you want both ways; and remember, that to a rail of two inches and a half, it will require a piece of timber six inches wide, to allow for the saw-carffs and planing up, especially if the opening doth not exceed two feet.

There is another observation, relative to the depth of the stuff, for the size of the rail, which requires some thought, if the plan consists of winders, and streight fliers to finish the story; for the learner must observe, that the turn required to the rail, both to the winders and from them is subjected to a cause, which he never would think of, (till either practice or instructions convinced him,) therefore it will be highly requisite for him to leave an inch more breadth to the fineers, than the depth of the rail; the ground of this maxim is, that no body of fineers applied one upon another in a rising state, if they are turned from their natural course, either up or down, but will vary in the laying, as much as the difference of the two twists, between the first mentioned state of rising, and that which the rail is turned to when continued to the fliers; and may be, according to the ground of the opening, one thirty-second part of an inch; therefore, if your rail requires to be glued in twenty-four or more inches thickness, you will be so many half-sixteenths of

an inch out of ſquare in the turning part, (more or leſs, according to the plan, and number of fineers required ;) therefore this width muſt be given to the fineers before they are laid, to be ſquared off after.

In order to lay fineers upon a cilinder, obſerve the following example : If you have no convenience for doing this, and are obliged to make uſe of bed-ſcrews or wedges, lay all your fineers upon the cilinder together, and ſcrew them down all the way dry, and having prepared pieces of wood to lay acroſs the rails at 9, 10, or 12 inches apart, and bored holes through them as may anſwer to be cloſe to the rail ; oppoſite to them bore holes in the cilinder, adequate to receive them. If your cilinder is of plank ſtuff, this will be ſufficient attraction ; but if thinner, I would propoſe the ſetting your cilinder upon ſtools, or legs, for convenience of getting underneath, and put the ſcrews through the under-ſide, and make uſe of the nuts upon the top for confinement ; and, having looſed one half, take the aſſiſtance of two men, one to hold up all the fineers, the other to lay them down ſucceſſively as you glue them, then all hands to fixing the ſcrews ; which, if well done, will be the moſt judicious method of doing any rail of this conſtruction ; then proceed to the other half as above.

My reader muſt obſerve, if the rail be for a regular plan, either circular or oval, he will have no occaſion to augment the width of his fineers more than what is juſt neceſſary for clearing off, becauſe the rail will come off the cilinder ready ſquared. With regard to the number of fineers to make the adequate thickneſs, you muſt be a little particular, in order to have a few ſhavings to plane off the outſide ;

outſide; becauſe where the ſcrews are applied, the fineers will naturally be moſt cloſe, and conſequently leave hills between, which will want planing off when ſtruck.

The learner may take notice, if he hath not leiſure to wait till the rail is dry, (which, in the beſt weather, will require three weeks) he may proceed as before, and glue down another by the ſide of it.

Many people of the profeſſion argue againſt rails of this ſort, and give a preference to gluing them up ſolid; but I cannot ſide with ſuch an opinion.

To an opening of three feet and a half, or four feet, where the rail may be cut out of one entire plank, it may be a feaſible method. The great particular of matching the ſtuff to ſmall-grounded plans (glued up ſolid) will ever raiſe objections againſt the rectitude of this mode of appropriation, beſides the danger of ſo many joints, and all glued acroſs the grain, which creates a fault in the ſtrength, and is in no wiſe equal to the purpoſe. However, if the learner is infatuated to this method, the beſt way that I can propoſe for the execution of it, is, ſtill to make uſe of a cilinder, and either cut the top off to the poſition and riſe of the ſteps, and ſquare from the perpendicular of it, which will be adequate to the ground; or elſe cut out your pieces, and fit them ſide-ways to the cilinder, by the noſings of the ſteps, as you would proceed with the fineers.

This work may be done without the trouble of making a cilinder, by finding or making a mould for the backing of the rail: but there is a great difficulty attends this, and it is hardly to be found correct. Every author that hath attempted the reſolution of laying this down, is in point of diſgrace; none having come at a proficiency, nor is it

it to be well done without practical alluſions: As I lay down no lines, and a deſcription without, in this particular, would be no advantage to the learner, I muſt beg his excuſe, and refer him to the true methods alluded to; which, when once he is in poſſeſſion of, will furniſh him with comprehenſions for any other ſubject of this ſort.

I beg to obſerve to the learner, that if the plan conſiſts of fliers and winders, in the meeting or joining of thoſe two parts he will be careful to give the rail as eaſy a turn as poſſible, and not directly follow the ſteps; and likewiſe, that he leaves wood both at the top and bottom ſide of his fineers, at the joining of the twiſt to the ſcroll; if it is a regular circular plan, it will require very little; and with the ſcroll proceed in every reſpect as to a ſtreight rail.

With regard to ſtrings to circular ſtairs, I would not propoſe the gluing them up in fineers, but ſolid; eſpecially, if the plan is only circular at one end; in ſuch a caſe glue them up and down in the manner of the cilinder; and cut to the ſection of the ſteps, at the upper edge; and at the bottom in a regular riſing ſtate, as in the ſtreight part.

Strings to circular ſtairs are worth per foot 4s. 6d.

LECTURE XLIII.

Of the VALUE *of* DOG-LEGGED-STAIRS.

	s.	*d.*
COmmon dog-legged ſtairs, with bearers and ſtrings included, the maſters charge from 9d. per foot to	1	0
Surveyors allow upon an average about 8d. ½, or	0	9

The

	s.	d.
The materials to ditto of yellow deal, bearers, ſtrings, nails, &c. upon the neareſt calculation are worth	0	3¾
The neat labour to ditto about 2d; therefore the univerſal price may be, per foot ſuperficial,	0	7
Rails and baniſters to ditto, of inch deal, planed ſquare to repreſent iron, are worth per foot, if balluſters are included, newels turned, capped, &c.	0	6
The labour to ditto is worth to a maſter	1	3
Maſters charge, when valued this way, per foot	2	6
Surveyors allow from 1s. 6d. to	2	3
Some ſurveyors meaſure the rail ſuperficial, including newels, at per foot	1	2
and allow per balluſter, with capping, &c. which comes partly to the ſame money.	0	3
If newels are not turned, nor capped, the price is, or ſhould be, per foot	1	9½
Ditto turned balluſters of 2 inch ſtuff, per piece	0	7
Bracket-ſtairs of ſtrong ſtuff, per foot, the maſters charge	1	3
If of ſecond-beſt riſers and covers	1	5
Surveyors allow to ditto, from 1s. to	1	4
The materials to ditto are worth, per foot, 5d. the neat labour well done, about 4d. ½; therefore the univerſal price ſhould be, per foot, 1s. or	1	1
The ſtrings meaſured at the above price; the architrave at 10d. per foot ſuperficial.		
The brackets, if plain, per piece,	0	9
If carved from 1s. 6d. to	2	6
Ditto of clean deal, per foot ſuperficial, the maſters charge, per foot, from 1s. 6d. to	2	0

The

	s.	d.
The ſurveyors allow from 1s. 3d. to	1	8
The materials according to the ground of the tread, if very good, are worth per foot	0	8
Labour to ditto about 6d. therefore we cannot ſtipulate the price at more per foot than	1	5
Architraves and brackets as before.		
Geometry-ſtairs, of clean deal, with a ſtring, are worth per foot ſuperficial from 2s. 6d. to	3	0
Theſe ſort both the maſters and ſurveyors in common are unacquainted with, it being rare to ſee one done this way.		
The materials to ditto with riſers of 2 inch ſtuff, good ſcrews, &c. are worth per foot, if they are wedged in a plank in the wall, I ſay, are worth, per foot ſuperficial, from 9d. to — —	1	0
Labour to ditto is worth to a maſter	1	10
Geometry-ſtairs moulded under the ſteps, according to the bracket, are worth per foot, from 3s. to — —	3	6
Materials to ditto are worth	2	0
Labour to ditto —	1	0
Mahogany hand-rails, ſcroll and ramp, the maſters charge per foot ſuperf. from 3s. to according to the goodneſs of the ſtuff.	4	6
The mahogany to ditto is worth per foot, of Jamaica wood, 6d. ½; of Rattan, 5d. labour to ditto is about 2s. per foot; therefore the real price ſhould be per foot	3	6
Surveyors allow from 2s. 6d. to	4	0

All circular rails double meaſure, which in ſome reſpects is too little, as weith-rails or ſo; if the ſurveyors will not be perſuaded

out of their humour, and will allow no more than double meaſure, the price ſhould be per foot — —	*s.* 7	*d.* 6
Labour to ditto, ſingle meaſure	7	6
And alſo allow 1 s. per foot for the cilinder, deal rails, ſcroll and ramp, is worth per foot — —	2	0
Maſters charge for ditto	2	3
Surveyors allow from 1 s. 6d. to	2	0

LECTURE XLIV.

Of Frontispieces.

THE word Frontiſpiece imports the fore-ſide or entrance of a door, uſually made more rich and beautiful than the reſt of the exterior work. There are many different ſorts of thoſe; but the moſt elegant are ſuch as are made according to the deſigns of one of the five eſtabliſhed orders, invented and delineated by the ancients. The moſt conſiderable of them for the purpoſe is the Doric, on account of the large projections of its cornice, which prevents the inclemency of the weather from affecting thoſe who may have occaſion to wait at the doors for admittance; a matter of very great conſequence.

The manner of appropriating the orders to frontiſpieces, is to lay aſide the pedeſtal, with all its appurtenances, and let the baſe of the column finiſh upon the firſt ſtep with a ſub-plinth.

The method of proportioning the Doric order to frontiſpieces, is to let the whole be guided by the proper ſymmetry of the door, in the following manner: Make the height of the door equal to two diameters;

diameters; after divide the width of the door into four parts, and one will be the diameter of the column; the height of the column, baſe, and capitol will be equal to 8 diameters; the architrave, frieſe, and cornice is 2 diameters high; the pedement is in height two-ninths of the width; the Doric column diminiſhes one-ſixth of the diameter at the bottom.

The Tuſcan door may be divided into four alſo, and one is the diameter of the column; the height of the column, with baſe and capitol, is equal to 7 diameters, the intablature 2, which makes the whole height 9 diameters; the pedement as before.

For the Ionic front, the door's width muſt be divided into 9 parts, and two is the diameter of the column; the height, with baſe and cap, is 9 diameters, and 2 the height of the intablature, which makes the whole 11 diameters high; the proportion of the pedement is the ſame as before.

To proportion a Corinthian frontiſpiece, divide the width of the door into 5 parts, and one is the diameter of the column; the height, with baſe and capitol, is 10 diameters; the intablature 2; the height of the pedement is 2-9ths of the width.

The general proportions of the Compoſite order are the ſame as the Corinthian.

The component parts to each front may be had by conſulting the orders, as a deſcription here would not make any addition, or be more clear than what may be ſeen by inſpection. The practice of frontiſpieces may be reckoned equal to any thing in the buſineſs; therefore it may not be amiſs to point out its properties, and where the difficulties lie, ſo that the learner may proceed with judgment and accuracy.

The design being fixed upon, and the several mouldings laid down at large, with the pitch of the pedement, diameter of the column both at the bottom and top, with the cap and base drawn from them, &c. the first thing the learner should turn his thoughts upon, is the gluing up the columns, which cannot be trifled with; for these being badly executed, will totally eclipse the beauty of the whole; notwithstanding, the whole mass of mouldings, and decorations, as the trigliffs, mutules, frets, caps, bases, as well as the circular-soffite, jamb-lining, &c. which are all very essential points, must be done well in their place, to render it an object worthy the notice of the public.

And first of the columns.

The learner must observe, that the customary method of gluing up columns, is to divide them at the base and cap into eight parts: which done will shew the thickness of the stuff required; to find this draw the lines across through the circumference, and after lay down the lines close by the outside of the circle, both at the top and bottom of the column, which will shew it in an octagon state, and point out the width of the staves both at the top of and bottom; which will vary as much as the column diminishes on one side: when you have got the width of the staves at the top and bottom, you must consider that the natural meaning of all columns is to be represented swelling, (either from the base or from one third of the shaft: but for fronts of doors I approve of the former method, or at least within one foot of the bottom;) and cannot be got otherwise than by diminishing the outside of the staves equal to one side of what the column diminishes to the top; therefore the first thing, after the stuff

ſtuff is ſawn out, is to diminiſh the ſtaves by a board cut for the purpoſe intended.

As the diminiſhing a column is a ſecret to ſome, I ſhall endeavour to point out a more clear and judicious manner than was ever offered to the public before.

Firſt, draw a circle for the ſize of the column below; and within it another, which will be the ſize of the top; and having drawn a line through the middle, for the diameter upon it, where the inner circle cuts, draw a line ſquare into the outward circle, which gives a portion of it, that the column diminiſhes; then, having got a board equal to the length of the ſhaft, divide it into any number of parts you like, ſuppoſing eight; next with your compaſſes divide that portion of the outward circle (that the ſquare line cuts off) to the diameter into eight parts alſo; and draw lines from each into the ſquare line, all tending to the center of the circles, which will give the ſcale: then take off each part, and transfer them into the diminiſhing board, from the ſtreight edge, and drive in brads at each point, about which bend a regular thin lath, which will form the diminiſhing-board required.

Obſerve, when you diminiſh ſtuff, if you are pinched for thickneſs, that you need not plane it all off at the top-end, for it matters not whether it is taken off the top or the bottom, ſo that it does but fit the templet above-mentioned; and be but at each end pricked off and planed to a regular thickneſs, that the pieces of cants, which muſt be glued on the inſide for ſtrength, fit the inſide of the ſtaves; having gone ſo far, ſet your bevel to the edge, and make a little templet to fit the outſide of two by the drawing when together, in order to try them, when you joint the edges; and glue two and two together firſt;

first; and then glue them in halves, and after glue the two halves together, which will compleat the whole; for a frontispiece you may perhaps want no more than 7 staves, in which case you must first glue 6 together by two's, and one more after, or joint them one against another in successions as other joints.

The learner must observe, that if the iron of his jointing-plane be not particularly square, when he comes to round his columns, his joints will be open, which will have a very disagreeable appearance, besides being very defective in point of strength.

The method of rounding a column is, to cut a board circular the size of the base, and another the size of the top, and nail them on to each end, having bored holes to put pins through at each end, hang them in a creel, by the side or on the top of the bench, for the advantage of turning them round; plane them to the templets at each end, and by the diminishing board for length, and your work is done.

Bases and caps are sometimes glued up as columns, and sometimes are got out as solid of different thicknesses; the latter method is much the strongest, though attended with more expence; observe in this last method, that the thickness of the stuff be always equal to the moulding, and that the joints be always in quirks and fillets.

Having done the columns, bases, and caps, the next thing of material consequence, is, the fronton or pedement, which is superior in size to the level work, in proportion to the pitch; therefore, the moulding and other decorations will require to be made adequate to the purpose.

The

The simplest way to find the size and curve of a raking-moulding, is, first, to draw the level one; from which, set out the height of the pedement, and draw lines parallel from the level fillets, by the raking-line, parallel to each other at the top end; in any part of the raking lines, draw the size of the moulding, equal to this width, with the projections of the level moulding, and draw a line through the face of each, the same as you would do to draw the curves of an o-gee or simarecta; and, having divided this face-line into any number of parts, draw them square from this last-mentioned line into the moulding, and transfer them to the raking part, which will give the points for tracing the curves; this may be done full as well by pricking off the curves in the middle of the level moulding, and transferring them to the raking one; and, after finding a center that will strike three pricks, will draw the raking curve required.

The way to cut a raking mould to mitre to the level one, is, to make a pitch-board equal to the rise of the pedement, and put it into the mitre box, and set the moulding upon it; then cut it in the same manner as another mitre.

The way to mitre a little o-gee round the block, and mutules in a pediment, is, to make a little jack for the purpose to shoot them in, and glue them on before they are put to the planceer; the learner must observe, that there must be three sorts of mouldings to cap a block upon the rake, which bears this analogy; as the level moulding is to the raking one, so is the raking ditto to the returning one of the top, and found in the same manner as the other; as the putting the different works together well, can only be acquired by practice, for any

any further explanation, muſt refer my reader, as it is impoſſible to communicate execution.

Of a circular Soffite to a Frontiſpiece.

The beſt method of gluing up what is called the the ſtiles of a ſoffite, is to do them in two widths, and break the joints; if they are to be ſtuck, that is, framed, you muſt be careful to turn the grain with the edge all one way, for the advantage of ſticking the moulding, and fineer the ſtiles the thickneſs of the ſquare of the plan; the beſt way of confining a fineer upon any concave circular-work, as the above ſtiles, or ſuch as may be wider, is, to plough a couple of pieces, and nail one faſt upon one end firſt, and thruſt the fineer round with the end into this plough-grove, which will give the exact length; then, when you have laid on your glue, thruſt it in as before, and put on the other piece likewiſe, and nail it faſt down upon the other end, and if your fineer is long enough, the glue will all be properly ſqueezed out without any other force.

If the ſoffite is plain, I would only make a fineer, and cut out ribs to bend it upon, with rails acroſs equal to the width, and proceed as before obſerved; after the fineer is on and dry, glue backings on the outſide, which is much the readieſt way, and will anſwer well the purpoſe; the jamb-linings are the ſame as to any other framing.

LECTURE

LECTURE XLV.

Of the VALUE *of* FRONTISPIECES.

FRONTISPIECES, if valued properly, should in every respect and part have a different price.

	s.	d.
First, the jamb-linings, which should be made particularly well, if of flat pannel, are worth per foot to a master —	1	0
Of raised ditto — — —	1	3
Of bead and flush —— —	1	0
The materials are worth per foot, whole yellow deal — — —	0	5
Surveyors allow, and masters charge, well done, from 10d. to ——	1	4
The ground to a front, the masters charge, per foot — — — —	0	8
Surveyors allow from 6d. to —	0	7½
The materials are worth 2d. ¾, the labour 3d. therefore the price may be —	0	7
If the columns, base, and cap, are valued together, which is a custom by some, the masters charge per foot from 1s. 9d. to	2	6
Surveyors allow the same, according as the work is executed; but the most general price is ——	2	0
The materials, to ditto, are worth per foot superficial, including the care of timber, which should be put through all columns, to take the weight off the base and cap	0	9
The neat labour, with expence of turning, per foot ——	0	8½
If for bases, are solid; the labour altogether well done ——	0	11

 There-

Therefore the real price ſhould be per foot ſuperficial ——	1	10
All the level mouldings, the maſters charge ——	1	2
Surveyors allow from 1s. to —	1	2
The raking mouldings ——	1	3
Mouldings of all frontiſpieces, as they are, or at leaſt ſhould be, all of good yellow deal, are worth per foot —	1	0
The architrave and cornice, with frieſe taken together, is worth per foot with the trigliffs, bells, &c. ——	2	6
The materials to ditto, are worth per foot ——	0	6
The method of valuing thoſe, is, to value the blocks or mutules at ſo much per piece, plain blocks from 9d. to —	0	1
Thoſe with bells in them, from 2s. to	3	6
The frieſe, at per foot, from 1s. 6d. to	2	0
All the mouldings at per foot —	1	3
The bearers and cover-boards at per foot	0	6
The columns ſhaft, per foot ſuperficial	1	6
The baſe and cap, per foot, at	2	6
The ſub-plinth, and plinth of the baſe, together at ——	0	7
Frets, under the planceer of the raking part, per foot —	2	0
Flutings, upon the facio, per foot	0	6

The above prices, which are the medium of many ſurveyors prices, are near enough, and not extravagant; the quantity of ſtuff for mouldings hath already been conſidered, therefore need no further explanation.

Fan-lights to frontiſpieces are done from 2s. per foot to ——	4	6

Some-

Sometimes they are paid by the piece, but this is an uncertain way.

LECTURE XLVI.

Of fluting Columns *or* Pilasters.

THE way to set out a column for fluting, is, to divide it at its base into ninety-six parts, and give one to the fillet, and three to the flute, which will just make in number twenty-four flutes, and twenty-four fillets.

The way to gauge a column for fluting, is, to fix a parallel piece to the middle of the column, and turn it round to every prick, or part, as you have set it out, and run the gauge streight along as in other work.

The method of gauging a pilaster, having divided it into twenty-nine parts, and given one to the fillet, and three to each flute, is, to make a gauge that will run half of them at one time, and after turn it to the other side for the other half: if the pilasters diminish, you must make a gauge with pricks equal to the whole, cut out to fit the width of the pilaster at the bottom, and, where it begins to diminish, turn the gauge a little a-skew, and continue so to the top, observing to keep the points of the notchings of the gauge close to the outside of the pilaster on both edges, so will your flutes be regular, and diminish properly. With regard to cabling columns and pilasters; some people have a method of working cables in the solid, with a plane made for the purpose; but, for my own part, I do not approve of it, because it doth not work clean. Columns fluted and cabled require the addition

of nine-pence per foot, or three-pence pence per foot run, of every flute and cable.

LECTURE XLVII.

Of Gluing up Corinthian or Ionic Capitols.

THERE is nothing very difficult in this work, save a judgment in appropriating the pieces to their proper places, and applying the grain of the wood the same way of the staves glued up; the best way to find which, is to draw the size of the capitol, with the leaves, abucus, &c. and their proper projections, which will point out the length and thickness of each piece. The same of the Composite capitol, &c.

Of Chimney-pieces.

Chimney-pieces are a great addition to rooms, and require clean execution; the mode of proportions assigned to them, is the dextrous result of fancy, which at present is in large estimation. There are many elegant and judicious designs published, which might serve as a standard of this sort of work; but custom having long ago bid defiance to propriety, and is now stalking abroad without let or molestation, what I have before said of mouldings should serve as an index to chimney-pieces as well as the rest of the works of this kind.

	s.	*d.*
Chimney-pieces the masters charge per foot from 1s. to	1	8
Surveyors allow from 9d. to	1	6
All plain chimney-pieces worked by hand are worth per foot	1	0
Ditto with breaks	1	3

With

	s.	d.
With dentils	1	6
Fret dentils are charged per foot run	0	6
Common fillet dentils per foot run	0	4
Frets to frieſes to ditto per foot run	2	0
Fluting in frieſes, 6 inches wide, per foot	2	6
Fluting upon facios per foot run	0	8
Flutings and beads in frieſes are per foot run — —	0	2

As chimney-pieces are a particular work, the above prices, are in general ſuch as take the medium, both with reſpect to the maſters charging, and what ſurveyors allow; therefore ſhall not enquire too ſtrictly into the merits of them, becauſe they are ſo very tedious, and take much time to execute.

LECTURE XLVIII.

Of a Circular Splayed Soffite in a Streight Wall.

A Circular ſplayed ſoffite in a ſtreight wall hath no great difficulty, after a proper curve is found for the ſtiles; the following method is without exception.

Firſt, draw the lines by the ſplay of the wall till they meet at a point; after transfer the length of theſe lines to another place; and having divided the circle of the arch into equal parts, and transferred them on to a ſweep ſtruck by the above radius, your ſtile is found; when bent round, will be the exact curb for the outſide of the wall; then ſet off the ſtile, and proceed as in other circular work.

LECTURE

LECTURE XLIX.

A Circular Splayed Soffite in a Circular Wall.

A Circular ſplayed ſoffite in a circular wall is upon the ſame principle as the above, though it requires more judgment in the execution.

EXAMPLE.

Firſt lay down the curve of the wall, with the ſplay of the jambs, and transfer them as before; then divide the circle into any number of equal parts, and transfer them to the curve ſtruck by the center, from the ſplay of the jambs; after draw the lines all to the center; then draw a ſquare line cloſe to the front of the outward curve of the wall; and, having drawn the arch a little below the windows opening, continue lines perpendicular from the parts, the arch was divided into, to the ſquare-line laid cloſe to the curve of the wall, and the ſweep ſtruck by the center and ſplay of the jambs, which will give the points for tracing the curve; which when held upon the ſplay, and bent round, will exactly anſwer the purpoſe: the outſide being once got, proceed with the beſt advantage.

Things of this kind very rarely happen; when they do, they ſhould be put into the hands of men of great experience, and good judgment. There is no value in reaſon can be fixed to this work: the method is to meaſure them four times; but this is too little at the common prices. This method will do in point of ſtuff; but if this work is framed, the prices ſhould be per foot 1 s. and ſubject to the above meaſurement. But jobbs of this kind, the ſurveyors

ſurveyors are obliged to learn the quantity of materials and labour of the maſters, and ſtipulate a price accordingly.

LECTURE L.

Of DRESSERS.

DRESSERS ſhould be always made of white deal very clean: there is nothing required in theſe but their value.

	s.	*d.*
The maſters charge for 2 inch dreſſers per foot — —	1	2
Surveyors allow from 1 s. to	1	2
The materials are worth per foot	0	6
Labour to ditto 4d. therefore 1 s. per foot is very reaſonable	1	0
Columns to ditto are worth per foot, 3 by 3, per piece —	1	6
Maſters charge for ditto from 1 s. 6d. to	2	0
Drawers are worth per foot of deal	0	7
Runners to ditto per foot lineal	0	2½
Shelves to dreſſers are worth per foot, of whole deal, —	1	7
Common horſe-plane cornice to ditto per foot run —	0	3

Of Slit-deal Linings.

All ſlit-deal linings are worth per yard, of white deal, ploughed, tongued, and beaded, —	2	2
Ditto of whole yellow deal 3 s. 10d. or	4	0
Bracketing to plaiſter cornices per foot run 5d. if 6 inches ſquare; if but 4 inches ditto	0	4

LECTURE

LECTURE LI.

Of Torus-Skirting.

		d.
TOrus-ſkirting is worth per foot	0	7
Ditto to ſtairs double meaſure.		

As there is a difficulty in putting this up to ſtairs, I ſhall give my learner a method, which, if he purſues with accuracy, he ſhall in this point never err.

EXAMPLE.

Firſt make two templets, one with the noſing cut out, ſo that it may go cloſe to the riſer; the other the width of one of the higheſt ſteps made parallel; lay the ſkirting-board cloſe to the noſings of the ſteps: then with the templet againſt the riſer mark all the lines for the riſers, and with the parallel board ſtrike out the lines to fit upon the treads; obſerve alſo, if the covers are a litte caſt, ſet your compaſſes to the part, and from the top-edge of the board prick off the deficiency downwards; and having procured a piece off one of the noſings, mark on the board as is required for every ſtep, thoſe exactly cut will fit at the very firſt time; if not, it is of little uſe; becauſe a ſecond ſcribing either up or down alters the noſings and the general tenor of the whole, which cannot be any-wiſe ſo well executed as at the firſt time.

Of Trunks.

	s.	*d.*
Trunks of good yellow deal, well pitched, are worth per foot from 10d. to	1	0
Labour to ditto.	0	3½

LECTURE LII.

Of Carpenters Work.

THough Carpenters work must be allowed and considered as the principal source of strength in every building, yet the practice of it is less irksome and difficult than many other of the interior parts of a structure, especially in London, where it is a rarity to see what may be called a piece of good carpenters work: not but there are many capital jobbs in this branch, though they seldom occur, except it is in the country, at the mansion-house of some nobleman, or gentleman, whose chief pleasure it is, and was, to erect something noble, to shew their regard for their paternal estates.

There is nothing very material in the practice of carpentry, more than what demonstrates itself by a drawing; therefore I shall not take up my reader's time with what he may esteem as trivial observations; and only give some few hints of the particular methods and properties, and proceed with the value and consequence of materials.

First of foundations, as it is the carpenters business to settle the particular under-filings, and subtraction, touching the solidity of the ground.

With respect to piles, or planking, I must advise him to have a particular care both for the benefit of of others, as well his own work; and weigh well the consequence of the superstructure by the intended size and height, in order, if possible, to prevent premature settlements, as well as the under conducts or conveyances of suillage, cess-pools for the soil, &c. that they likewise be in no-wise detrimental to the natural grounding of the foundation.

When his mind is at reſt with reſpect to the baſis of his building, he muſt then turn his thoughts to the centring for the vaults. There are various forms of thoſe; but the ſtrongeſt, in my opinion, is the circular; for if bricks or ſtones to thoſe were cut wedge-wiſe, and diſpoſed in the form of an arch all from one center, the bricks or ſtones can in no-wiſe ſink downwards, for want of room to deſcend perpendicular; becauſe all ſolid materials muſt deſcend directly downwards, for ponderoſity hath a natural tendency to the center of the world, and nature will perform her works by the ſhorteſt lines; neither can the butments of a ſemicircular arch ſuffer ſo much as one made flatter, becauſe the roundneſs of it will rather incline the weight to reſt upon, than ſhove them out.

There is no difficulty in either making or ſetting of centers, but what every man that hath ſerved a time to the buſineſs muſt naturally know; notwithſtanding, I ſhall not omit to acquaint my reader, that the moſt familiar method of ſetting centers, is, to cut pieces of quarter equal to the length at the top and bottom, and ſet your bearers upon wedges, for the convenience of eaſily ſtriking them; alſo if the vault is groined, to keep them up conſiderably in the middle, to prevent a defect in appearance by the ſetting of the arch; a thing very common in arches or vaults of a great ſpan.

As ſome young men may be unacquainted with the nature of ſtriking out centers, the following is a certain method, for every part or a portion of a circle whatſoever.

EXAMPLE.

EXAMPLE.

Firſt draw a baſe line equal to the width of the arch you intend; from the middle raiſe a perpendicular equal to the height, and likewiſe continue it below the baſe line; then from the height to the point of half the width, draw an hypothenuſe line, in the middle of which ſet to your ſquare, and draw a line into the perpendicular, which will be the center required: and ſo of every other circle.

An eleptic may be ſtruck with a trammel for a rough arch; but the moſt exact and beſt method is to divide half the width and the height into any number of equal parts, and draw interſection of lines, which will form the arch deſired.

The centers being done, the next thing that requires the carpenters thoughts, is, the plates for the floors to reſt upon in the walls, which are of the greateſt ſervice imaginable, both with reſpect to ſtrength, and form in practice; alſo, if the building is of no conſequence, and requires binding-joiſts, conſider well the nature of them, both with reſpect to ſcantling and diſpoſition, and that they by no means exceed 3 feet 6 inches apart, or 4 feet at the fartheſt, to prevent too great a ſcantling for the bridgings.

The practice of this work is familiar; the binding-joiſts are mortiſed into the girder fluſh with the under-ſide, and ſo much below the top as will allow the thickneſs of the bridgings to be equal with the top of the girder; the binding-joiſt mortiſed near the under-edge, for the ceiling-joiſts at one end, and ſlip into a chaſe-mortiſe at the other.

Partitions come next under our examination, but require no difficulty: the principal thing in

partitions lies in the judgment of properly placing the braces, ſo as they may in ſome meaſure ſerve as a kind of bument or ſtay one to another; where thoſe are uſed, they are both of ſtrength in ſupporting the upper floors, beſides are a tye to the building by the top-rail being dove-tailed upon the plates, though ſhould not be too frequently uſed, being leſs ſerviceable than partition-walls; having mentioned thoſe things, we will not doubt but the ingenious carpenter, will, from the hints before given, remember the adjuncts of ſtrength and convenience, ſuch as bond-timbers, lintels, diſcharging-pieces, taſſels, and have them put in their proper places, for the advantage of putting up his own work, and turn our thoughts to the great conſideration of every building, which is the roof, and hath a two-fold meaning, both of equal conſequence. The firſt, is, the natural notion of the benefits intended, which is a ſhelter or covering from the inclemency of the weather; the ſecond, is, the extremity of the properties of this covering, which requires ſome thought, that they may not be inconſiderately applied as too heavy or too light; (both of which I have in my lecture of ſtrength hinted at) the former hath the common objection of preſſing too much the under-work; the latter (though of leſs danger) is always ſubject to the power of a ſtorm.

With regard to the height of the pitch of roofs, the natural effect of the climate ſhould be the only guide; for if the ſituation where we build is cold, and ſubject to heavy falls of ſnow, the pitch ſhould be particularly higher, to give a fall to the gathering-weight; though, I think, the common pitch, underſtood by every workman, will be high enough for any part of this kingdom; and ſomething

thing under this, will do for all the cities and large towns, especially for pan-tiles.

The principal thing, in the practice of roofing, is the scarfing, or the raising of wall-plates, to find the length and backing of the hip-raftors, to contrive the trusses, that they may take part of the weight from the beams of the principals, and also be a shore to the length of the raftors; also, to lay out the different skirts of the roof in ledgement, to find out the real length of every piece, as well as the quantity of stuff required.

LECTURE LIII.

To find the Length of a Hip-raftor to any Angle.

FIRST, upon your drawing, lay down the principal you hip the roof to, and make a line through the middle of the plan, which is the base of the ridge; then draw the base-line of your hip; from this base-line, in the point of the base of the ridge, raise a perpendicular, and prick off the height of the pitch of the roof, from which prick, to the outward point of the base line at the angle, draw the hypothenuse, which will be the length of the raftor required; after, set off the thickness at the top and bottom, and you have the form of the hip-raftor with the bevels at each end.

LECTURE LIV.

How to BACK *a* HIP *for any* ANGLE.

DRAW a line acrofs the angle of the roof, parallel from each corner, at any diftance; in the middle of this line (which will be upon the bafe of the hip) fet the point of your dividers, and extend the other to the neareft place againft the infide of the hip juft laid down, then turn your dividers to the bafe-line towards the ridge, and make a mark, which drawn to the outward points of the parallel line, will give the backing of the hip required.

I think it needlefs to fay any thing concerning the method of mortifing and tenanting roofs together, or of truffing of girders, or fcarfing of plates, fince Langley and others have fo largely defined thefe things; an immediate recourfe to them will fhew, and, moreover, are much plainer by infpection than defcription.

It may not be amifs to mention that tie-beams fhould not be more than ten feet apart, and well pinned down upon the plates; the ftrength of a dove-tail being infufficient for the ftrength required, that the pieces you appropriate to tie the angles, be of fufficient fcantling, well pinned down alfo, to keep every part in due form, and adequate to the purpofe.

LECTURE

LECTURE LV.

Of the PROPER SCANTLING *of* TIMBERS.

Scantling of Girders.

IF the length of a girder of fir be

Ft.	In.		In.
12	9½	by	8½
14	11	by	9
16	12	by	10½
18	13	by	12
20			
22	14	by	12½
24	15	by	13
26	16	by	13½

Of Binding-Joists.

If their length be

Ft.	In.		In.
8	6	by	5
10	7	by	5
12	8	by	5

Observe, that no joist should exceed 12 feet in length, and lay 6 inches into the wall.

Of Bridging-Joists.

	Ft.	In.		In.
Length	3	3	by	3
	4	4	by	4

Common

Common Floorings where neither Binding or Bridging-Joists are used.

	Ft.		in.		in.
Length	10	Their scantling should be	7	by	3
	11		8	by	3
	26		9	by	3

Of Fir-Beams.

Length.	Scantling.			But if of oak.		
Ft.	In.		In.	In.		In.
30	6	by	7	7	by	8
45	9	by	8½	10	by	11½
60	12	by	11	13	by	15

Principal Rafters.

	Length.							
	Ft.	its scantling at the bottom must be	in.		in.	at the top	in.	in.
If the rafters be of fir	24		6	by	7		5	6
	36		8	by	10		6	8
	46		10	by	12		8	9½

If of oak at bottom.			If at the top.		
In.		In.	In.		In.
8	by	9	7	by	8
9	by	10½	8	by	9
10	by	12½	9	by	10

Small Raftors.

Length.	Scantling.		
Ft.	In.		In.
8	3½	by	2½
10	4½	by	2½
12	5½	by	2½

Purlines must be in large buildings, (where they are framed into principal raftors,) 9 inches by 8; in small buildings, when laid into the collar-beams, 4 by 5½; raising-plates, and all wall-plates should be 9 by 5; lentils and discharging-pieces, 9 by 6; bond-timber, 6 by 2½; tassels ditto.

LECTURE LVI.

Of the VALUE *of* CARPENTERS WORK.

	£.	s.
FRaming of floors, with binding-joints, and all materials of oak, from 2l. 15s. to	3	10
when the timber is valued in scantlings at 3s. per foot.		
Surveyors allow, when both girder, binding-posts, bridgings, and cielings ditto, are, of oak, from 2l. 10s. to	3	5
Note, the materials to a square of the above floor are worth, when the oak is cut to scantling, at 2s. 8d. per foot	2	8

Labour to ditto 10s. therefore 3l. 5s. per square is as little as can be allowed.

As materials of every kind vary in every county, I must beg my reader to abide by

the labour in this particular for the country, and value his ſtuff at a fair appraiſement. £. s.

Floors of fir, with binding-joiſts, the maſters charge per ſquare from 1l. 10s. to 2 2

Surveyors allow about 1 16

The materials at 1s. 6d. per foot in ſcantlings are worth — 1 4

Labour to ditto 8s. 6d. therefore the price ſhould be about — — 1 18

Common naked floors, the maſters charge per ſquare, of fir, from 1l. 8s. to 1 18

Surveyors allow about the ſame for thoſe as the bridging floors; becauſe the quantity of materials run near the ſame; the latter rather more.

The price of theſe floors is not extravagant, of fir, at per ſquare, 1 18

The neat labour to thoſe is about 6s. the maſters charge 0 9

Surveyors allow 8s. 6d. which ſhould be the univerſal price for labour.

Framed partitions ſcantlings 4 by 3, the maſters charge per ſquare, from 1l. to 1 5

Surveyors allow per ditto 1 0

The materials are worth, of fir, 12s. the labour to a maſter 8s. therefore we will call it — — 1 2

Ditto truſſed partitions, labour is worth per ſquare — — 0 10

All bond-timbers, lintels, diſcharging-pieces, &c. are charged at 1s. 6d. per foot cube.

Framing of king-poſt roofs, with purlines, &c. per ſquare of fir, the maſters charge 3 10

Surveyors allow from 2l. 15s. to 3 0

The

	£.	s.
The materials per square of this sort of framing are worth about 2l. 3s. the neat labour 10s. therefore the price should be	2	18
Labour only of this work to a master is worth per square —	0	14
Common roofs with a ridge-tree the masters charge per square, with all materials, from 1l. 15s. to	2	0
Surveyors allow according to pitch from 1l. 10s. to — —	1	16
The materials to a square of this sort of roofing, with raising-plates, tie-beams, ridge, &c. are worth — —	1	6
Labour to ditto to a master is worth 9s. therefore the price is low enough at	1	15

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	s.	d.
Extra-work to trussing of girders, beams, &c. at per foot run, of oak,	0	6½
Ditto of fir, per ditto	0	5
Bridged guttering, of whole deal, is worth per foot superficial	0	6½
Ditto with oak-bearers	0	7½
Raftors feet and eaves-boards for slate, per foot superficial	0	4½
Door cases, framed of fir, rabbited and beaded, at per foot cube, masters charge	2	8
Surveyors allow from 2s. 6d. to	2	8

The labour to one is worth per cube 1d. and the materials 4 by 4½, to a door of 6 feet 6 inches by 3 feet 3 inches, are worth 1s. 8d. therefore the price of 2s. 8d. is little enough; the best way of valuing those is to measure them superficial at 4d. per foot.

Centring for groins, per ſquare, maſters charge — s. 12 d. 0

The ſurveyors allow from 9s. to — 11 0

The materials waſted, &c. may be valued at — 6 0

The labour to making, ſtriking, &c. to a maſter in worth very well 6s. therefore the ſtandard is — 12 0

Framed quarter-paces to ſtairs per foot, with materials, from 8d. to — 1 0

Leading pieces of fir, per foot cube, — 2 0

LECTURE LVII.

Of Plumbers Work.

PLumbers work is all valued by the long hundred or 112lb. and bears a price according as it weighs per foot, from 4lb. to 12lb ditto, and is of different ſorts, as ſheet lead, and milled ditto; the former is uſed for all gutters, platforms, and covering of roofs; the latter for ridges of houſes, hips, tops of cornices, &c.

I think it but of little uſe to enter into the quality of lead, (which is of various ſorts) ſince the plumbers have an opportunity of giving you what ſort they pleaſe.

The plumbers method of doing their buſineſs is to value their work at ſo much per hundred; and after charge you the time for laying, and finiſhing, which I think is a very weak as well as indolent method, and fit only to encourage their men in idleneſs.

The price that plumbers charge for 7lb. to the foot, is, from 1l. 2s. to — £. 1 s. 3

Surveyors allow — 1 2

The

The value of lead, considering the waste in the melting, is worth per hundred about 19s. therefore 1l. 2s. is sufficient. I think it a folly in surveyors to allow more per hundred for lead of 10lb. or 11lb. per foot, than 7lb. which is the general rule, let the plumbers custom be what it will.

The true and genuine method of valuing plumbers work, is, to state the price for sheet-lead of any weight above 7lb. to the foot at 1l. 3s. per hundred, which will allow 1s. per hundred laying, which is quite sufficient.

	£.	s.	d.
Milled lead is of a thinner and finer quality, and should be per foot laid and soldered, at per hundred	1	5	0
The price of casting and laying lead is from 3s. to —	0	3	6
Casting old lead, and the plumbers make up the deficiency	0	4	9
Water-pipes, from 1 inch to 8 inches bore, solder and labour included	1	7	0
Rain-water-pipes, and pumps, per hundred —	1	8	0
Water-pipes of large bore per yard or hundred weight.			
The customary allowance by plumbers for old lead is 14s.			
Sash-weights at per hundred	1	1	0
Solder per pound 8d. ½, or	0	0	9
The price of soldering water-pipes is 2s. 6d. per joint to —	1	2	0
One of ¾ inch bore is —	0	2	6
1 inch ditto —	0	3	0
1 ½ inch —	0	3	6
2 inches —	0	4	0
3 inches —	0	6	6
4 inches —	0	9	0

One

	£.	s.	d.
One of 5 inches —	0	12	0
6 inches —	0	15	0
7 inches —	1	0	0
7 ½ inches —	1	1	0

All dimensions between those bear an exact proportion.

The price of stop-cocks are per pound	0	1	3
Ditto, setting on solder and labour, at per cock, of an inch and half diameter	0	8	0
Ditto, ½ inch, at per cock	0	3	0
One inch ditto —	0	5	0
Brass-cocks, of an inch and half diameter, with bosses, solder, and setting on, per cock —	0	7	0
Ditto, of inch, per cock	0	4	0
Ditto, ½ inch, per cock	0	3	0

LECTURE LVIII.

Of Masons Work.

HAving already said so much of the principles and properties of building, I hope my reader will excuse a dissertation on Masonry, as the volume is already stretched beyond the intended size. Notwithstanding, it is a noble art, and bears its date ever since the first intent of Jabel, the son of Lamech, who invented the first house of stones and trees.

Masonry hath in its practice every definitive principle of geometry, and is not surpassed by any of the liberal arts.

The way that masons value their work solid, is, first to consider the cubical measurement of the stone,

ſtone, and the work as ſuperficial, reckoning nothing for what is not ſeen, accounting all ſtone under two inches as ſuperficial; what is above this, or 3 inches, as ſolid meaſure.

	s.	d.
Key and aſhler fronts, of Portland ſtone, the maſters charge per foot ſuperficial	1	6
Surveyors allow from 1 s. 3 d. to	1	6
Beſides, meaſuring the ſolidity of the key-ſtones, or bonds, which go through the wall, and charged per foot cube	3	9
The value of materials to a foot of key and aſhler work, conſidering the ſawing and the veins that often are detrimental in the opening of a block of ſtone, which cannot before be ſeen, is worth, with materials to ſetting, per foot ſuperficial 9 d. labour to ſquaring, rubbing, fitting, &c. is worth 6 d. therefore the price allowed by ſurveyors is not in the leaſt exorbitant at	1	6
Plain-work, as curbs to iron-rails, &c. at per foot ſuperficial	1	2
The ſtone at per foot cube	3	0
Holes for iron-bars, cut in ditto, at per pce.	0	2
Portland aſtragal ſteps are worth per foot ſuperficial —	1	0
the ſolidity of the ſtone as before.		
Ditto, plain ſteps, per foot ſuperficial	0	6
Portland coping, a foot wide, per foot run	1	10
Mouldings of Portland ſtone, of all ſorts, at per foot ſuperficial	1	7
Circular ditto —	1	9
the ſtone meaſured as ſolid.		
Slips and mantles to chimnies, of Portland ſtone, are worth at per foot ſuperficial	1	0
Ditto, ſuperficial moulding to chimnies with ſtone, per foot —	1	8

Portland

	£.	s.	d.
Portland slabs at per foot	0	1	0
Portland paving at per foot superficial	0	1	6
The shafts of columns, of Portland stone, per foot superficial —	0	1	2
Bases and caps to ditto —	0	3	0
Ditto columns fluted, and cabled of stone, labour only, —	0	1	9
the Stone valued as before.			
Doric intablatures of stone at per foot superficial — —	0	5	6
Carving the capitols of Corinthian and Compositive orders at per foot superf.	0	11	0
Italian marble at per foot cube	1	1	0
Plain work on dittto, as slips and mantles, at per foot —	0	4	0
Slabs of ditto at — —	0	4	6
Dove marble in slabs at per foot	0	5	0
Mouldings of chimney-pieces, &c. of any sort of marble at per foot superficial, from 3s. 6d. to — —	0	5	0
the marble valued extra.			
Marble, of different sorts, must be valued according to its quality, and is from 1l. 1s. per foot cube to	3	0	9
Small mouldings of marble at per foot run from 6d. to	0	1	0
Portland geometry-steps are worth per foot superficial	0	1	0
The stone for those must be valued at per foot —	0	3	6
on account of the variety of blocks that must be opened before those can be all got sound.			
Fire-stone covings with materials at per foot superficial	0	1	2

Ditto

	£.	s.	d.
Ditto in hearths per ditto	0	1	1
Purbeck ſteps, at per foot run with ſtone,	0	2	6
Purbeck paving in random-courſes, at per foot	0	0	7½
Old purbeck paving at per foot ſquared and new laid	0	0	2

My reader may perhaps wonder why I have not in maſons work proceeded with the value and labour as in other work. I own it was my intent, but hearing of the laudable deſign now on foot of the maſters raiſing the mens wages three ſhillings per week, I therefore made the digreſſion, knowing well that their prices will not be in the leaſt extravagant when that is put in execution; therefore, I hope, as my whole motive is deſigned for the benefit of mankind, I ſhall be freed from all aſperſions in the above particular, in deviating from my general plan.

LECTURE LIX.

Of ESTIMATING *in General.*

I Almoſt think it unneceſſary to mention eſtimating in general, ſince I have been ſo particular in all the component parts of a building, which might be by the learner eaſily put or compiled together; however, to prevent every argument that might be offered, touching my neglect, I ſhall propoſe the ſimpleſt and moſt conciſe method in my power, in order that the learner may have no doubt of my fully acquieſcing with every particular

of my propoſals, as well as my ardency to ſerve him in every article that occurs to my memory.

Many ſurveyors have, or propoſe methods for eſtimating, by knowing the exterior dimenſions of a building, that is, gueſſing at the expence by the number of ſquares the houſe contains; but this is a very uncertain rule, and can never be followed with any degree of certainty, unleſs all buildings were finiſhed in one manner, and conſiſted of no other variations than the ſize of the ſtructure; in ſuch a caſe a proper criterion might be formed; but, as this never can happen, it is obvious that any examples laid down of this nature could only (like the artiſt, who pretends to the world, he hath a power adequate to the uncertain changes of fortune in the calculation of the lotteries) amuſe, without the leaſt benefit or advantage.

The only and general thought required in eſtimating a building, is, to be well appriſed of the intent, both reſpecting the ſize of every part and particular, as well as the manner and mode of execution; without a concluſion of theſe principles, the greateſt judge in nature, can only gueſs at the expence; theſe things being fixed, the drawings will point out the ſize of every part, and the prices before mentioned, applied to every particular, according to the different dimenſions, will form a near certainty for the whole.

If the learner hath no drawings given, and has only an idea propounded by the gentleman, what ſort of a ſtructure he would chuſe, and what expence he had ſettled within himſelf, to be finiſhed after ſuch and ſuch a manner; let him make firſt, a drawing of the plan and elevation, (having firſt examined the ground for the conſequence of the under-filings) by which he will

will be able to come at the expence of the piling, planking, &c. if any required; proceed then to take the value of the foundation, as digging and taking away the earth, next the brick-work, ſtone, &c. in the foundation, which is eaſily calculated as I have before obſerved, according to the height of the building; then the expence of the brick work only, in the baſement-ſtory, both outward and inward walls, vaults and ceſs-pools, &c. then the brick-work in the firſt ſtory, or ground-floor; and ſo from ſtory to ſtory, to the top of the edifice, toping of chimneys, &c. with all the arches, tiling, and every other incident in brick-layers work.

Secondly, according to the ſize of the houſe, let him calculate the ſcantlings of the different timbers in every ſtory for the floors, as well as the lintels, wood-bricks, diſcharging-pieces, bond-timbers, &c. what is meaſured cubical, and what by the ſquare, as well as door-caſes, centers, both for vaults, openings, and apertures, not omitting the trimmers, whether arched or coach-headed, roofing, plates, tie-beams, guttering, boarding, raftors-feet, nor any vacuum, where a piece of timber may be required.

Thirdly, the ſaſh-frames and ſaſhes, throughout the whole houſe.

Fourthly, the covering, whether lead, ſlate, or tile, &c.

Fifthly, the joiners-work in every room, on every floor, the quality as well as quantity of materials, not forgetting the furring of walls, floors, &c. bracketing to cornices, glue, nails, and every other incident; likewiſe, the ſtairs in every reſpect and part, according to their bearings, whether with or without carriages; nails, ſcrews, glue, templets, cilinders, &c. the caſualty of removing lumber and

other incidents, that may retard the progreſs of your practice.

Sixthly, the plaiſterers-work after the ſame manner in every room, with the gentleman's propoſals of ornaments, decorations, &c. making allowances for the inconveniences that generally attend the progreſs of their work, by ſcaffolding, &c.

Seventhly, the maſons-work both without and within, as ſteps, aſhlers, facios, coping, quoins, ruſticks, pavings, floors, hearths, jambs, mantles, coverings, caps, carvings, &c. all according to their different ſize and value; omitting nothing in this buſineſs more than the reſt.

Eighthly, the painters-work all through the houſe; every floor ſeparate, and let every part and portion that hath variations be ſtrictly nominated: the number of times required to be done over, with obſervations of fronts, and other work that is paid by the foot, whether run or ſuperficial.

Ninthly, the glaziers-work in every reſpect and part the ſame as in other branches.

Tenthly, the carvers-work alſo in every article, which muſt be moſt ſtrictly conſidered in every point, becauſe of the great expence attending this beautiful branch.

Eleventhly, the plumbers-work, both touching the capping of cornices, fronts, facios, gutters, hips, vallies, fixtures, pipes for ſuillage, pumps, drains, water-cloſets, &c. ſoldering, and every other incident required.

The ſame of ſmiths-work, paviours, &c. that will cauſe any expence.

After thoſe matters are all noticed, ſum up the whole, to anſwer the ſketch given; if you run above the ſtipulated price, ſuch contractions in the mode of finiſhing muſt be made as will reduce your plan

plan to the gentleman's propoſals, if he will not be reconciled otherwiſe to what the purport of his intention amounts to.

The beſt and moſt ſure way to be perfect, and to a ſtrict nicety in every particular, is to make drawings of every room and part with the ornaments prefixt, as well as the ſection, plan, and elevation of the whole: alſo, mark every room, and every branch to each apartment or floor; and in ſumming up the whole, take care to allow a ſufficiency for caſualties, that in the execution you may not much exceed your ſtipulated ſum, and incur the gentleman's diſpleaſure.

LECTURE LX.

SCHEDULE *of* PRICES *to* TASK-MASTERS.

Of Carpenters Taſk-Work.

	s.	*d.*
KING-poſt roofs with purlines, &c. and fixing on the irons at per ſq.	10	0
Ditto common roofs per ſquare	6	6
Bridged floors, with binding joiſts included, at per ſquare —	8	6
Common naked floors per ſquare	6	0
Ceiling ditto per ſquare —	7	6
Truſſed partitions —	5	6
Common partitions per ſpuare —	5	0
Plates, bond-timbers, diſcharging-pieces, lintels, &c. at per hundred feet run	3	0
Centring to vaults rough —	4	6
If groined —	5	6
Centers to apertures at per foot	0	1½
Bridged-gutters at per foot ſuperf.	0	3
Ditto vally-boards per foot —	0	1½

Raftors-

other incidents, that may retard the progreſs of your practice.

Sixthly, the plaiſterers-work after the ſame manner in every room, with the gentleman's propoſals of ornaments, decorations, &c. making allowances for the inconveniences that generally attend the progreſs of their work, by ſcaffolding, &c.

Seventhly, the maſons-work both without and within, as ſteps, aſhlers, facios, coping, quoins, ruſticks, pavings, floors, hearths, jambs, mantles, coverings, caps, carvings, &c. all according to their different ſize and value; omitting nothing in this buſineſs more than the reſt.

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The ſame of ſmiths-work, paviours, &c. that will cauſe any expence.

After thoſe matters are all noticed, ſum up the whole, to anſwer the ſketch given; if you run above the ſtipulated price, ſuch contractions in the mode of finiſhing muſt be made as will reduce your plan

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Bridged floors, with binding joiſts included, at per ſquare ——	8	6
Common naked floors per ſquare	6	0
Ceiling ditto per ſquare —	7	6
Truſſed partitions ——	5	6
Common partitions per ſpuare —	5	0
Plates, bond-timbers, diſcharging-pieces, lintels, &c. at per hundred feet run	3	0
Centring to vaults rough —	4	6
If groined ——	5	6
Centers to apertures at per foot	0	1 3/4
Bridged-gutters at per foot ſuperf.	0	3
Ditto vally-boards per foot —	0	1 1/2

Raftors-

	s.	*d.*
Raftors-feet and eaves-board per foot run	0	$1\frac{3}{4}$
Framing the carcases of houses per sq.	6	6
Door-cases per foot	0	$1\frac{1}{2}$
If rabbited and beaded	0	2
Bracketing to plaister cornices run	0	$1\frac{1}{2}$
Clean-dowelled-floors per square	17	0
Second best ditto	15	0
Streight joint ditto of board	8	0
Ditto with battins	10	0
Folding-floors per square	6	0
Furring-joists per square	1	2
Listing-boards per list	0	$0\frac{1}{2}$
Doors ovolo and flat on both sides per foot	0	6
Ditto stuck on one side square back	0	$3\frac{1}{2}$
Doors with fancy-mouldings quirked per foot	0	7
Astragal-mouldings on the pannels to ditto at per foot run	0	2
All window-shutters per foot ovolo, and flat, square behind, hung single	0	6
Ditto hung double	0	7
if stuck with a quirk moulding.		
Bead and flush behind, and hung double, are worth per foot	0	10
Astragal-mouldings on the pannels to ditto	0	2
Back-shutters framed square	0	$3\frac{1}{2}$
If bead and but hung double	0	$4\frac{1}{2}$
Plain clamped back-shutters per foot	0	$2\frac{1}{2}$
Framing linings	0	3
Doors bead and flush, &c. both sides, per foot	0	8
Ditto beaded on one side	0	5

Bead

	s.	d.
Bead and fluſh ſhutters to outſide work	o	5½
Saſhes and frames with oak-caſings, ſoils, beads, &c. together —	o	7
Ditto with mahogany ſaſhes	o	8½
Fir ſaſhes and frames together per foot	o	5
Venetian and Palladian window-frames and ſaſhes at per foot	2	o
Mouldings of all ſorts at per foot	o	6
Columns at per foot	o	10
Pilaſters ditto —	o	6
Fluting columns, or pilaſters, the flutes at per foot run —	o	1½
If cabled as far as the length of ditto	o	2½
Doric frieſes at per foot ſuperficial	o	10
Doric blocks plain per foot	o	6
Raking ditto —	o	8
Ditto with enrichments —	2	6
Frets 6 inches broad, per foot	2	o
Small frets per foot, run	o	6
Fluting of facios per foot run	o	5
Frieſes fluted and bead per foot run; the plane of the frieſe at per foot ſuperficial	o	2½
The beads and flutes run at	o	1½

The method of meaſuring ditto, is, to take the length of one flute, and multiply the number of flutes in the frieſe.

	s.	d.
Terms to chimney-pieces per foot ſuperf.	o	9
Gluing up Ionic caps for carvers at per piece —	2	o
Corinthian ditto per foot ſuperficial	o	6
Dado per yard —	1	6
Torus ſkirting per foot	o	2½
Up ſtair-caſes double meaſure.		
Horſe-plane courſes per foot run	o	1½
O-gees per foot run	o	o¾

Dog-

	£.	s.	d.
Dog-legged ſtairs at per ſtory	1	8	0
Bracket ditto per foot ſuperficial	0	0	4½
Ditto with clean ſteps	0	0	5
Newels at per foot run	0	0	4
Strings at per foot ſuperficial	0	0	6
Balluſters per piece	0	0	3
If dove-tailed —	0	0	4
Geometry-ſtairs moulded underneath as the bracket, per foot	0	0	9
Or per ſtep —	0	10	6
Steps hung in the wall at per foot	0	0	8
The ſtring at per foot, if upon a circular or oval plan —	0	1	6

There is a method of doing geometry-ſtairs without a ſtring, although they be not moulded underneath the ſteps. This is done by mitring the bracket, and fixing it to the end of every ſtep, before they are put up, and leaving them long enough to exceed the width of the under-ſide of the ſtep, ſo as the ſucceeding one ſhall take and lay upon this, in regular form all the way to the top; after they are up, you may ſhoot ſtreight the under edge of the brackets, which will appear like the under edge of a ſtring; alſo, when they are up, you may put up a fillet on the inſide, which will bear the ends of the laths, and be a kind of ſtiffening to the brackets, or artificial ſtring.

Theſe are much the cheapeſt of all ſtairs, and may be done to any plan, with a good appearance, by putting a neat aſtragal moulding to the lower edge, juſt under the noſings.

The learner may obſerve, that thoſe brackets need not be longer than what will be adequate to receive the furrings, and the laths and plaiſter. My

My reader will excuſe my making this digreſſion. Theſe ſort of ſtairs I had omitted mentioning in their proper place; however, I will cloak my neglect under the old proverb, that it is better late than never.

	s.	d.
Theſe ſorts of ſtairs are worth per foot, labour only, when hung in the wall	0	7½
Plain brackets to ſtairs per piece	0	6
Circular ditto —	1	0
Mahogany hand-rails to ſtairs to circular plans, glued in thickneſſes, at per foot ſuperficial —	7	0
The cilinder, either done by day, or allowed per foot, the run of the circular part of the rail —	0	4
All twiſts to ſcrolls —	5	0
Streight rail of mahogany	1	3
Ramps double meaſure, or	2	6
Deal ſtreight rail	1	0
Twiſt to ditto —	4	0
Shelves per foot —	0	3½
Linings of all ſorts —	0	2½
All plain linings to door-caſes	0	3

LECTURE LXI.

Of BRICKLAYERS TASK-WORK.

	£.	s.	d.
THE maſter to find all materials and ſcaffolding,			
Common brick-work, per rod	1	3	0
Camber arches, rumbed gauged and ſet, per foot	0	6	0
Circular ditto	0	7	0

	l.	s.	d.
Ditto to a nitch per foot	0	3	6
A circular arch upon a circular plan double meaſure	0	1	0
Brick cornices per foot ſuperficial	0	2	6
Plain tiling per ſquare	0	5	0
Ditto pan-tiling pointed	0	5	0

LECTURE LXII.

Of Plaisterers Task-Work.

	s.	d.
ALL ceilings per yard	0	5
Ditto walls with three coats on laths	0	5
Ditto two coats floated	0	4
Walls floated per yard	0	3½
Stucco per yard	0	8
All plain cornices per foot	0	4½
Ditto fully enriched	1	0
Common block cornices per foot	0	8
Dentil ditto	0	7

LECTURE LXIII.

Of Masons Task-Work.

SOmetimes maſons let their men to taſk-work, though it is but ſeldom; I ſhall therefore mention two or three prices in particular caſes, and which may be a better method of calculation than what they generally go by in taſk-work.

The maſons method of taking work is by the piece in many jobbs, as frontiſpieces, &c. but I think it rather an irregular mode of proceeding, without one advantage to recommend it.

Fron-

Frontiſpieces of the Doric order, when done by the piece, may be charged from 10l. to 12 guineas, according to the enrichments that are upon them; but the beſt way is to meaſure them by the foot ſuperficial, and value the different works after the following prices.

	s.	d.
The columns at per foot ſuperficial	0	8
Baſes and capitols per ditto	2	9
Fluting and cabling columns in Portland ſtone, the run of the flutes at per foot	0	5
All mouldings at per foot	0	7½
Frieſes to Doric cornices per foot	5	0
Mutules level at per piece	4	0
Raking ditto —	4	6
All the plain work per foot	0	5
Portland ſteps per foot run	0	7
Geometry ditto, and ſet off, per foot run	0	8
Paving with Portland ſtone, per 100 feet, from 5s. to ——	8	0
Purbeck in random-courſes per 100	4	6
Old Purbeck taken up, new ſquared, and re-laid, at per 100 feet	3	9
Key and aſhler fronts per foot	0	4
Holes cut for iron paliſades per piece	0	1½

As there is ſeldom any other branches done taſk-work, I beg my reader, when he hath other ſorts of work, and not above mentioned, he will have recourſe to the other parts of the book, where the labour required is proved, and get as much as he can.

Frontispieces of the Doric order, when done by the piece, may be charged from [illegible] to [illegible] guineas, according to the enrichments that are upon them; but the best way is to measure them by the foot superficial, and value the different works after the following prices.

The columns at per foot superficial	0	[illegible]
Bases and capitals per ditto	2	[illegible]
Fluting and cabling columns in Portland stone, the fluted Pilasters at per foot	0	[illegible]
All mouldings at per foot	0	[illegible]
Friezes to Doric cornices per foot	[illegible]	[illegible]
Mutules level at per piece	[illegible]	[illegible]
Raking ditto	[illegible]	[illegible]
All the plain work per foot	0	[illegible]
Portland steps per foot run	0	[illegible]
[illegible] ditto, and [illegible] per foot run	0	[illegible]
Paving with Portland stone, per foot	[illegible]	[illegible]
[illegible] ditto	[illegible]	[illegible]
[illegible] chimney-pieces per foot	[illegible]	[illegible]
[illegible] when [illegible] and [illegible] per foot	[illegible]	[illegible]
[illegible] and other [illegible] per foot	0	[illegible]
[illegible] cut for [illegible] per foot	0	[illegible]

[illegible] is a [illegible] any other ornamental stone [illegible] when the [illegible] will [illegible] to the other parts of the work, where the [illegible] of work, and prices [illegible]

A TREATISE OF ARITHMETIC:

Adapted to and propoſed for Students in the

BUILDING BRANCH.

A

TREATISE

OF

ARITHMETIC.

LECTURE LXIV.

INTRODUCTION.

ARITHMETIC is a Greek word, and imports an art or ſcience that teaches the uſe and properties of figures, or the right art of numbering and denoting any given quantity with proper characters and to expreſs them by words which is called Notation. There are many kinds of notation by which quantity is expreſſed, but what I mean in this lecture to treat of, is figural, or the manner of expreſſing quantities by the ten Arabic characters, viz. 1, 2, 3, 4, 5, 6, 7, 8, 9, 0.

Arithmetic is divided into three parts, two of which are properly called natural, and the third artificial:

The firſt is that kind of Arithmetic which is called Vulgar, and which is the doctrine of whole numbers, and the moſt plain and eaſy, becauſe every unit,

unit, or one, (which is called an integer) denotes or signifies one intire thing, or quantity, of some kind of species; as a stone, a rule, &c.

The second, is the doctrine of broken quantities, or parts of units, or integers, which is called Vulgar-fractions; and wherein the unit, or integer, is divided into a number of even or uneven parts: as for example.

If a foot be the given or proposed unit, or integer, and be divided into twelve inches, then one inch becomes a fraction or twelfth part; two inches one-sixth, three inches one-fourth part thereof.

This part of arithmetic may be considered either as pure, consisting of fractional parts only, each less than an unit; as quarters, halves, &c. or of integers and fractional parts intermixed; as one and a half; two and one third-part of one, &c.

The third part which is called Artificial, is also called Decimal-arithmetic, which is an artificial method of working fractions and broken numbers, in a different and (by some thought) much easier than that of vulgar-fractions.

Decimals took their name from the Latin *Decem*, or ten, into which every integer is supposed to be divided; and in many cases every sub-division is subdivided again into ten lesser parts, &c. Suppose one foot in length to be an integer, or unit given, and let it be divided into ten equal parts, then we say the foot is decimally divided; and if every tenth-part be decimally divided again in the like manner then the foot will be divided into one hundred parts, and is then said to be centesimally divided.

LECTURE

LECTURE LXV.

Of NUMERATION.

NUMERATION is accounted the first part of Arithmetic, and it is to know how to read a sum of figures expressed in writing; or to write down any sum to be expressed; to the doing of which there are four things necessary; first to know the number which is nine; secondly their shapes which are 1, 2, 3, 4, 5, 6, 7, 8, 9, of which the first toward the left hand ever signifieth one; the second two, the third three, &c. thirdly to know the value of their places; lastly, how their proper signification is attained thereby.

The value of their places is thus: when two, three, or more figures stand in one sum, that is, without any point, line, or comma betwixt them, as 321, that place next the right-hand where the figure 1 standeth, is called the place of unity, or units, and the figure 1 standeth in that place for 1 only, and the figure 2, when it is found in that first place, stands only for 2, and so of all the rest.

But in the sum 321, above expressed, the figure 2 in the second place, and every place contains the value of that place before towards the right hand ten times; therefore the figure 2 doth not in this second place signify 2, but ten times 2, that is, 20; and so the figure of 3, if it had been in that second place would have signified ten times 3, that is, 30, but being here in the third place, it signifies ten times 30, that is, 300, and so the whole sum 321 is to be read three hundred and twenty one.

It is hereby seen how their proper significations, which were three, two, and one, are altered by

being thus placed, and the ſum, which would but have been ſix, is three hundred twenty and one.

In like ſort, if there had been more places, as ſeven, the value is quite through increaſed ten times, by being a place more towards the left hand, as in the ſum 1111111; the figure 1 in the ſecond place ſtands for ten times one, that is, ten; in the third for ten times ten, which is one hundred; in the fourth for ten hundred, which is called a thouſand; in the fifth for ten thouſand; in the ſixth for ten times ten thouſand, which is an hundred thouſand; in the laſt, or ſeventh place, for ten hundred thouſand, which is called a million; and ſo on, if there were more places. Obſerve the ſame order to infinity, beyond all earthly value.

Now, to read this readily, make a prick over the place of unity; another the third from it, and over every third, ſtill towards the left-hand; for ſo thoſe points will be over the places of units, thouſands, and millions; and ſo beginning at the laſt figure that is at the left hand, read one million, and becauſe the three following towards the right ſignify properly one hundred and eleven, but the prick belonging to them laying in the place of thouſands, call one hundred and eleven thouſand; and the three remaining being under the point over unity, ſignify only one hundred and eleven; and all three points, read together in one ſum, make one million one hundred and eleven thouſand one hundred and eleven.

In like manner, if this number 87654352, were given to be read (according to the former direction) make pricks over every third figure, beginning with the firſt figure towards the right hand, (which is

is the place of unity) and then will your number ſtand thus 87654352; then for the ready reading of them, (becauſe the third prick ſignifies millions) call all the figures towards the left hand from that prick, millions, which in the example are 8 and 7, begin and ſay 87 millions 654 thouſand 352, which at length, are eighty ſeven millions ſix hundred and fifty four thouſand three hundred and fifty two; and ſo any other number in like manner.

LECTURE LXVI.

Of ADDITION.

ADDITION is the gathering or collecting of two or more ſums, either of one or of divers denominators, into one ſum, which is called the aggregate, total, or groſs ſum. In addition of numbers of one denomination, the order is to ſet the numbers to be added, one directly under the other; that is to ſay, units under units, tens under tens, hundreds under hundreds, thouſands under thouſands.

RULE.

Having placed your numbers to be added in due order one under another, draw a line under them, and begin at the lowermoſt figure towards your right hand, and add that to the next figure above, and the ſum of them to the next figure above that, proceeding in this order till you have added the line together; which when done, conſider how many tens are contained in that line; and for every ten carry one to the next column; but if there are any odd digits, you muſt ſet them down beneath the

ſtrke, juſt under the line you have added together; having thus finiſhed the addition of one line, proceed to the next; and from thence to the third, and ſo forward be there never ſo many. The following will make this plain.

Example the Firſt, of whole Numbers.

Let the ſeveral ſums given to be added be 9874, 6436, 1423, 6788; having thus placed them under one another, as in the margin is done, draw a line under them; then begin your addition at the lowermoſt figure to the right hand, ſay 8 and 3 is eleven, and 6 is ſeventeen, and 4 is twenty-one, there is 2 tens and 1 remaining, I place the 1 under the line, and carry the two tens to the next row, ſaying 2 which I carry and 8 is ten, and 2 is twelve, and 3 is fifteen, and 7 is twenty-two, in which row there is two tens to carry, and 2 remains which I place as before; again proceed to the next column, ſaying 2 and 7 is nine, and 4 is thirteen, and 4 is ſeventeen, and 8 is twenty-five, ſet down five and carry two again to the next, ſaying, two I carry and 6 is eight, and 1 is nine, and 6 is fifteen, and 9 is twenty-four, which ſet down under the margin; ſo the aggregate or groſs ſum is twenty-four thouſand five hundred and twenty-one.

9874
6436
1423
6788
24521

In the addition of divers denominations, this is to be obſerved, viz. place all the numbers of the ſame denomination one directly under another, as inches under inches, feet under feet, yards under yards, ſquares under ſquares; then draw a line under them, and begin your addition with the ſmalleſt number or leaſt denomination firſt, always obſerving

ing how many times the next greater denomination is continued in that leaſt; and for every time carry one unit to the next place, as before you did the tens, taking care to ſet down the remains if any be; then add the next denomination together, taking care how often the next greater denomination is contained in that, and ſo proceed be they ever ſo many, from parts to inches, inches to feet, feet to yards, yards to ſquares, rods, poles, or perches.

As all the parts of addition are built upon the ſame reaſon, ſo the method of pointing may ſerve as a general rule, when any denomination is to be added, and this may be done without defacing the figures.

EXAMPLES.

Let the ſeveral denominations to be added be ſet down as in the margin, ſuppoſe the work of different rooms done be as follows:

	Yds.	Ft.	In.
To dado on the ground floor	127	7	6
To ditto one pair of ſtairs	162	5	3
	290	3	9

Proceed and begin at the inches, ſaying, 3 and ſix is 9, which I write under the inches, and as 9 inches is leſs than a foot, you have nothing to carry to the next denomination, but ſay 5 and 7 is twelve; now, as 9 ſquare feet are a yard, you muſt ſet the remainder three under the denomination of feet, and carry one to the next column, ſaying, 1 and 6 is ſeven, and 2 is nine, which ſet down and ſay 1 and 1 is 2, which makes 290 yards 3 feet 9 inches.

A ſur-

A ſurveyor having meaſured and ſquared the different dimenſions of brick-work, ſet them down for addition as follows:

	Rods	Ft.
To foundations, vaults, &c.	6	50
The ſeveral walls in the firſt ſtory	9	80
Ditto to the ſecond	8	43
Attic-ſtory ———	6	84
Gable-ends and chimnies	1	19
	31	4

My reader muſt obſerve that a rod of brick-work is 272 and $\frac{1}{4}$, therefore muſt prick at 272 feet; if not ſo much, ſet down the remains of feet, and add up the rods, and theſe examples may ſerve for every thing elſe of whatever denomination.

Addition of Feet and Inches.

Ft.	In.
53	6
42	7
82	9
178	10

Note, for every 12 inches carry one to the feet.

Addition of Yards, Feet, and Inches.

Yds.	Ft.	In.
12	9	4
7	4	3
13	6	2
33	7	9

Note, as nine feet are a yard, ſo at every nine feet you muſt carry 1 to the yard as in the example.

Addition

Addition of Lime and Sand.

Example the First, of Lime.

	Hun.	Bags.	
Collect into one sum these several quantities of lime, viz.	3	14	Rule, for every 25 bushels carry one to the hundreds, which add as integers.
	4	06	
	5	12	
	3	13	
	16	20	

Note, twenty-five bags, which ought each to be a bushel, is accounted one hundred of lime in London; and in many countries 30 bushels is called a load.

Of Sand.

	Loads	Bushels	
Collect into one sum these several quantities of sand.	27	04	Rule, for every 18 bushels carry one to the loads, and add them, as whole numbers.
	26	15	
	29	12	
	16	18	
	100	13	

Note, a load of sand is 18 heaped bushels.

Addition of Bricks.

	Loads	Bricks	
Note, 500 bricks are a load, add these several quantities into one sum, viz.	2	148	Rule, for every 500 carry one to the loads, and add them as whole numbers.
	6	193	
	4	050	
	7	240	
	20	131	

Of

Of Timber and Planks.

Collect into one sum the several quantities, viz.	Yds.	Ft.	For every 50 carry one to the loads, and add them as whole numbers.
	7	33	
	8	40	
	5	23	
	4	12	
	26	08	

Note, 50 feet solid make one load.

Of Solid Yards.

Yds.	Ft.	
7	04	Note, for every 27 carry one to the yards.
2	22	
6	15	
4	13	
21	00	

Having done so much of addition, I shall conclude the lecture with this observation, that one load of earth is one solid yard.

A hundred weight of lead, nails, iron, &c. is is 112 pounds; a hundred weight of deals or nails six score or 120 lb.

A bundle of five feet laths 100, and of 4 feet ditto 120, which should be 1 inch and ½ broad, as it is expected a bundle of laths of whatever length is to cover the same; for what is wanting in length is made up in number.

LECTURE

LECTURE LXVII.

SUBTRACTION

Of FEET, INCHES, *and* PARTS.

	Ft.	In.	qr.	Ft.	In.	qr.
From	274	7	2	364	2	4
Take	153	5	1	173	8	4
	121	2	1	190	6	0

Note, that in inches you borrow twelve.

Subtraction of Yards, Feet, and long Inches.

Yds.	Ft.	In.	Yds.	Ft.	In.
40	7	6	23	2	6
32	4	2	13	4	7
08	3	4	09	0	11

Note, as you borrow 12 at the inches, and carry one to the feet, ſo you borrow 3 at the feet and carry 1 to the yards.

Subtraction of ſquare Yards and ſquare Feet.

Yds.	Ft.	Yds.	Ft.
47	5	82	7
36	9	43	8
10	5	38	8

Note, here at the feet you borrow 9 and carry one to the yards, becauſe 9 ſquare-feet makes a ſquare-yard.

 Sub-

Subtraction of solid yards.

Yds.	Ft.	Yds.	Ft.
55	17	78	18
43	29	53	20
10	15	24	25

Here, as 27 feet is a yard solid, so you borrow 27 at feet, and carry 1 to the yards.

Of squares of flooring, &c.

Square	feet.	Square	feet.
94	11	26	04
13	72	19	40
80	39	06	64

Here, as 100 square feet make one square, so at the feet you borrow 100, and carry 1 to the square.

As there is nothing more in subtraction to be observed than the denominations of which you borrow, I shall think these examples sufficient, and proceed to multiplication.

LECTURE

LECTURE LXVIII.

Of Multiplication.

Multiplication is that part of arithmetic which teacheth how to increase one number by another, so that the number produced by their multiplication shall contain one of the numbers multiplied, so many times as there are units contained in the other.

Multiplication may fitly be termed a compendium of addition, for that it performeth at one operation the same which to effect by addition would require many. For instance: If it were to know how many 4 times 8 is, to perform this by addition I must set four figures of 8 one under another, and by adding them together I shall find that the total will contain 32. But this by multiplication is with far more brevity, as by examples hereafter shall appear.

Before you enter upon the practice of multiplication, it is necessary to remember the product arising by the multiplication of any of the nine digits by any other of the same, as readily to know that 3 times 4 are 12, 6 times 7 are 42, 8 times 8 are 64, &c. &c.

In multiplication it is necessary to know the product of any two of the nine digits or figures; for which purpose the following table must be studied till you have it by heart.

MULTIPLICATION TABLE.

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	15	18	21	24	27	30	33	36
4	8	12	16	20	24	28	32	36	40	44	48
5	10	15	20	25	30	35	40	45	50	55	60
6	12	18	24	30	36	42	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	16	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	99	108
10	20	30	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144

In multiplication there are three things or terms to be obſerved, that is to ſay, the multiplicand, the multiplier or multiplicator, and the product.

The multiplicand is the number to be multiplied. The multiplier is the number by which the multiplicand is multiplied. And

The product is the number which is produced by the multiplication of the multiplicator and multiplicand together: Thus

If

If it were required to multiply 9 by 6, here 9 is the multiplicand and 6 the multiplier, and these numbers multiplied make 54, which is the product; for 6 times 9 is 54, or 9 times 6 the same.

In multiplication it matters not which of the two numbers is the multiplicand, or which the multiplier, for the product produced by either will be the same. But the common way is to make the greater number the multiplicand, and the lesser the multiplier.

RULE I.

The numbers to be multiplied must be set one under another, viz. the multiplicand (or greater number) above, and the multiplier (or lesser number) below; the last number of the multiplier under the last figure of the multiplicand; then draw a line under them, and having learnt the preceding table by rote, multiply every number of the multiplier into every number of the multiplicand, and set the several products under the line; then having finished your multiplication, draw a line at the bottom, and add all the products together, and the sum of these products will be the general product, as by the following examples will appear.

Example the First.

Let it be required to multiply 872 by 6; first, I write down 872, the multiplicand; and under it 6, the multiplier; then under them I draw a line as in the margin; then I multiply 6 into every digit of the multiplicand, saying 6 times 2 are twelve; place 2 under the line directly under the 6, and for the ten keep one

$$\begin{array}{r} 872 \\ 6 \\ \hline 5232 \end{array}$$

one in your mind to carry to the next figure; then I ſay 6 times 7 are 42, and one I carry makes 43; then ſet down 3, and keep 4 in your mind for the four tens to carry to the next, ſaying, 6 times 8 are 48, and 4 I carry make 52, which ſet down, and the work is done; and the product is 5232.

Example the Second.

Let it be required to multiply 5753 by 24; ſet them down as before, and proceed in the ſame manner, ſaying, 4 times 3 are 12, place 2 under the 4, and carry 1; 4 times 5 are 20, and 1 I carry makes 21; ſet down 1, and carry 2; then 4 times 7 are 28, and 2 I carry make 30; ſet down 0 and carry 3; then 4 times 5 are 20, and 3 I carry make 23, which ſet down alſo; then begin with the 2, ſaying, 2 times 3 are 6, which place under 1; then 2 times 5 are 10, ſet down an 0, and carry 1; and 2 times 7 are 14, and 1 I carry makes 15; ſet down 5, and carry 1 ſtill: then 2 times 5 are ten, and 1 I carry makes 11, which finiſhes both the digits. This done, I draw a line under them, and add the two ſums together, which make 138072 as in the margin.

5753
24
23012
11506
138072

Examples for Practice.

43672	7643215	87462
200	4003	100
8734400	22929645	8746200
	29572860	
	29595789645	

In

In the firſt example I have contracted my work by placing the 2 of the multiplier under the unit of the multiplicand, which ſhould always be done when the other figures to the right hand are all cyphers. In the ſecond I made a contraſt by omitting the cyphers in the multiplier, and multiplying only by the 3 and 4; but when this is done, you muſt be careful to ſet down the firſt figure of your remains directly under the place of your multiplier. In the third example I have contracted my work by adding the number of cyphers in the multiplier to the multiplicand for the product, becauſe one neither multiplies nor divides.

Examples for Practice.

Multiplication of integers may be performed without giving any trouble to the mind, by carrying on the tens as in the firſt examples ſhewn. Mind the operation.

Multiply 97643 by 4, as in the margin; ſay 4 times 3 is 12, ſet down 12, as is obſerved in the example; then 4 times 4 is 16, ſet 1 at top next the 12 to the left hand, and 6 at the bottom under the ſecond figure in the multiplicand; then 4 times 6 is 24, which ſet down, 2 at the top and 4 at the bottom; then 4 times 7 is 28, which ſet down as the reſt; then 4 times 9 is 36, which ſet down as before, and add the two ſums together, and you will have the true product required. And this example will ſerve, let the multiplier conſiſt of any number of figures whatſoever.

$$\begin{array}{r} 97643 \\ 4 \\ \hline 322112 \\ 6846 \\ \hline 390572 \end{array}$$

More

More Examples for Practice.

Let 53568 be multiplied by 24, as under.	Multiply 83647 by 33.
53568	83647
24	33
212232	201121
0204	4982
101116	201121
0602	4982
1285632	2760351

Note, these examples are the same as the first, only twice repeated; observe, when the product of any figure is less than ten, place a cypher before it to the left as below, by the product of 2 in the first figure; if after it is less than 10, set the product at the bottom, and a cypher at the top.

See the operation.	In order to prove, this observe the operation by the common way.
78492	78492
82	82
110104	156984
4688	627936
563716	6436344
6422	
6436344	

As

As I have thus finished the multiplication of integers, you must observe that therein is this analogy, viz. as an unit is to the multiplier, so is the multiplicand to the product; for supposing one load of rough timber costs 40 shillings, how much will 10 loads cost?

RULE.

If 10 load be multiplied by 40 shillings, the product 400 shillings, as in the margin, being considered as an unit, bears the same proportion to 40 shillings, the multiplier, as 10 loads, the multiplicand, doth to 400 shillings the product.

$$\begin{array}{r} 10 \\ 40 \\ \hline 400 \end{array}$$

LECTURE LXIX.

Of MULTIPLICATION *of* DECIMALS.

I Will not in this place treat upon the peculiar excellencies or antiquity of this sort of arithmetic, but immediately proceed to a few examples, and then finish my treatise on multiplication with duodecimals, or what is vulgarly called cross-multiplication with aliquot parts. Multiplication of decimals, both in placing the multiplicand and multiplier, is the same as multiplication of integers, only when your work is done, you must observe, that with a dash of your pen, you cut off as many places of decimals in your product, as there are places of decimals both in your multiplicand and multiplier; and in case of want in your product, prefix cyphers to your left hand.

It may be well to observe, that it will be convenient to make that number the multiplicand which

contains the moſt places, though ſometimes it may perhaps be leſs in quantity; ſecondly, that if the multiplicand and multiplier be both decimals, that is, be both parts of integers, the product will be decimals; thirdly, if the multiplicand and multiplier be mixed, that is, integers and decimal parts of integers, the product will be mixed; and, laſtly, if the multiplicand and multiplier be mixed, and the other is a decimal, the product will be ſometimes mixed, and ſometimes a decimal.

Example 1.	Example 2.	Example 3.
Of Decimals alone.	Of Integers and Decimals.	Multiplicand mixed. Multiplier a Decimal.
.5764	4.3625	27.5462
.732	2.13	.234
.11528	130875	1101848
17292	43625	826386
40348	87250	550924
.4219248	9.292125	6.4468108

In example the 1ſt, of decimals alone, the product is .4219248 parts of an integer divided into 10,000,000, becauſe the denominator of every decimal conſiſts of as many places of cyphers annexed to 1, as there are places in the decimals.

In example the 2d, there being 6 decimal places in the multiplicand, I have therefore cut off 6 places of figures from the product, and the product is 9 integers, and 292125 parts of an integer divided into 10,000,000, parts.

In example the 3d, I have cut off 7 places of decimals, 4 in the multiplicand, and 3 in the multiplier,

plier, and the product is 6 integers 4468108 parts of an integer divided into 10,000,000 parts.

LECTURE LXX.

Of DUODECIMALS, *or what is vulgarly called* CROSS-MULTIPLICATION.

AS in decimal-multiplication the integer is divided into 10 parts, so here in duodecimals it is divided into 12 parts, as a foot into 12 inches, or a shilling into 12 pence; in the following example I suppose the integers to be feet and the decimals inches; this kind of multiplication may be performed as well by taking the aliquot, or even parts of 12, out of the multiplicand, (as will be immediately shewn) as by multiplying the multiplier into the multiplicand; but before I proceed to practice, observe, that the aliquot (which are the even) parts of a foot, are as follow, viz. in 12 there are 6, which is the half of a foot, and must be so taken in the example; three times 4, four times 3, six times 2; eight times 1 $\frac{1}{2}$; and twelve times 1.

In this kind of multiplication there is a great variety; and as I think it the most familiar, concise, and easy rule extant, for measuring, I shall give various examples for practice, and leave my reader to take which he most approves himself; but before we begin, observe the following table.

When the multiplier is multiplied into the multiplicand, note,

Feet multiplied by feet, give feet.
Feet multiplied by inches, give inches.
Feet multiplied by seconds, give seconds.
Inches multiplied by inches, give seconds.
Inches multiplied by seconds, give thirds.
Seconds multiplied by seconds, give fourths.

Example First.

Here I multiply the 6 ft. and 3 in. by 4 ft. 4 in, (which gives feet and inches for the product) saying 4 times 3 is twelve, set o under the inches, and carry one to the feet; then 4 times 6 is 24, and one I carry makes 25, which set down as in the margin; next I multiply 6 feet 3 inches by four inches, saying, 4 times 3 is twelve, which I set down under the place of seconds, or parts, as observed in the table, and carry one to the inches, saying, 4 times 6 is 24, and one I carry is 25, which are 2 feet 1 inch, which set down as in the example.

Ft.	In.	Pts.
6	3	0
4	4	0
25	0	0
2	1	0
27	1	0

Example Second.

Ft.	In.	Pts.
9	7	0
6	3	0
57	6	0
2	4	9
59	10	9

Example Third.

Ft.	In.	Pts.
4	6	0
6	4	0
27	0	0
1	6	0
28	6	0

Example Fourth.

Ft.	In.	Pts.		
8	3	6	0	0
6	2	4	0	0
49	9	0	0	0
1	4	7	0	0
0	2	11	2	0
51	4	6	2	0

The

The following examples are another method of multiplying feet, inches, and parts, by multiplying the multiplier into the multiplicand.

Ft.	In.	Pts.		Ft.	In.	Pts.		Ft.	In.	Pts.	
16	4	6		8	6	4		9	4	3	
		0	4 in.			0	6 in.			0	7 in.
5	5	6	4	51	0	2	0	5	5	5	9

These examples may be used when you want to multiply feet, inches, and parts, by inches; or any aliquot part of a foot, as, in the above examples, which are 16 feet, 4 inches, and 6 parts, multiplied by 4 inches by placing the multiplier one place farther to the right hand, and then multiplying as in whole numbers: the second and third example are the same.

To multiply Feet and Inches by taking the aliquot Parts.

Now, supposing your dimension of several rooms of mouldings, or any thing that is measured by feet and inches, as in the margin; 263 feet 6 inches by 26 feet 6 inches; it would be too much for the head to say 26 times 6, as in the first examples; therefore I multiply the feet into the feet first, saying, 6 times 3 is 18, set down 8 and carry one as in whole numbers; and 6 times 6 is 36 and one I carry is 37, set down 7 and carry three; then 6 times 2 is 12 and 3 I carry is 15, which set down; then begin with the 2, say, 2 times 3 is 6, which set down under

Ft.	In.
263	6
26	6
1578	0
526	0
131	9
13	0
6983	9

der the multiplier as in whole numbers; 2 times 6 is 12, ſet down 2 and carry one; then 2 times 2 is 4 and one I carry is 5, which is the whole.

Now as they are multiplied into themſelves, inſtead of multiplying the feet and inches take the aliquot part of a foot for the inches, which in this example are the half, being 6 inches, ſaying, the half of 2 is one, which ſet down directly under the figure you ſo divide, and the remains, when there are any, carry to the next inferior part, as from feet to inches, inches to parts, &c. and for every integer ſo remaining muſt be reckoned as 12 from feet to inches, and the like from inches to parts, &c. But to proceed, I have ſaid the half of 2 is one, then the half of 6 is 3, and the half of 3 is 1, and one remains, which I carry to the inches, and call it twelve, which added to the 6 inches in the multiplicand makes 18; then I ſay the half of 18 is 9, which I ſet down under the inches, and proceed to take half of the multiplier 26 feet by 6 inches, in the multiplicand, which has not as yet been conſidered, ſaying, as before the half of 2 is 1, and the half of 6 is 3; my reader will obſerve, that the 6 inches in the multiplier was before taken, therefore place the ſeveral ſums in proper order as in the margin, and add them together, which makes for the product 6983 feet 9 inches. It matters not whether feet be firſt multiplied, or aliquot parts taken, ſo their reſpective products be all duly added together.

Example.		*Example.*		*Example.*		
Ft.	In.	Ft.	In.	Ft.	In.	Pts.
345	3	946	6	433	6	0
16	4	44	2	23	7	0
2070	0	3784	0	1299	0	0
3450	0	37840	0	8660	0	0
0115	1	00141	1	0144	6	0
0004	1	00022	0	0108	4	6
				0011	6	0
5639	2	41787	1	10223	4	6

The above examples will, I hope, be plain enough by inſpection and needs no more than this obſervation, that if the aliquot part be 11 feet 9 inches or 7 inches, I take them at twice as in the laſt example of 7, which I took at 3 and 4, being both aliquot parts of a foot as before-mentioned.

To multiply feet, inches, and parts, by feet, inches and parts, when the feet in the multiplicand and multiplier do not exceed twenty.

R U L E.

Firſt, place the feet of the multiplier under the parts of the multiplicand, and the inches and parts to the right hand, and proceed to multiply as in whole numbers; only with this difference, carrying 12 for the remains. See the examples:

Ft. In.

Ft.	In.	Pts.		
8	6	4		
		6	3	2
	1	5	0	8
2	0	7	0	
51	2		0	0
53	4	2	0	8

Ft.	In.	Pts.		
12	6	4		
		3	6	4
	4	2	1	4
6	3	2	0	
37	7	0		
44	4	4	1	4

Having thus given you various examples of feet, inches, and parts; I ſhall obſerve, that theſe being well underſtood will make the menſuration of either ſuperficies or ſolids eaſy and delightful to every capacity. As ſome works are meaſured by the yard and feet, I ſhall juſt give a little inſtruction in this ſort of meaſurement, and proceed to diviſion.

Multiplication of yards and feet.

Obſerve, that yards multiplied by yards produce yards; yards multiplied into feet, every 3 is a yard, and the remains more than three are long feet; what I mean by long feet, is, 3 feet in length, and 1 broad. Feet multiplied by feet produce parts of a foot; which are ſquare feet, 3 of which make a long foot.

	Yds.	Ft.
	463	2
	223	1
	1389	
	926	
	926	
B	154	1
C	74	
D	74	
	93551	1

See the example in the margin.

Firſt, the yards being multiplied as integers, proceed to take the feet, which I do thus, as one foot is one third of a yard as aforeſaid, I take the thirds of 463 yards 2 feet, which is 154 yards 1 foot, as at B; ſecondly, as 2 feet are two thirds of a yard, I take the third twice of 223 yards, which is 74 each, and place them as in the margin; and add them all together you will have the true product which is 93551 yards, 1 foot.

LECTURE LXXI.

Of DIVISION.

DIVISION is quite the contrary to multiplication, for that turns small denominations into greater, but division turns greater to smaller, and therefore is no more than a compendium of subtraction; for as many times as the divisor can be subtracted out of the dividend, so many units are in the quotient.

In whole numbers, of which only I shall yet speak, Division is the asking, how many times one sum is contained in another; and the number which answereth to that question is called the quotient; 2dly, the number containing is called the dividend; 3dly, the number contained, or by which the dividend is to be divided, is called the divisor; and as often as the dividend contains the divisor, so often doth the quotient contain unity; so that as multiplication is a compendium of many additions, so division is a compendium of many subtractions.

There are many ways by which this difficult rule of division may be wrought, but some much easier than others to be performed; therefore, as ease and perspecuity are the fundamental principles on which I build all my designs, I shall endeavour, in this as well as every other lecture, rather to instruct the ignorant, than point out new modes and studied maxims, to acquire the self-praise of the already accomplished.

Division in general is performed by this analogy; as the divisor is to 1, so is the dividend to the quotient; which I shall illustrate by the following examples.

Example the First.

A	B	C
100	436	4
	400	
	36	

If it is required to divide a floor which contains 436 feet into ſquares, as one ſquare contains 100 ſquare feet, place them as in the margin; 436, the dividend as at B; then making a diviſion, place it at 100, as at A; then make another, and placing it as at C, ſeek how often 100 is contained in 436 feet, which is 4 times: ſet down 4 as at C, for the quotient; multiply the 100 that is the diviſor by the quotient 4, ſaying 4 times 0 is note; which place under the 6, and ſay 4 times 0 is note again, and place an 0 under the 3, then ſay 4 times 1 is 4, which place under the 4 as in the example; then make a line at the bottom of theſe numbers, and ſubtract from the dividend, ſaying; 0 from 6, and there remains 6; 0 from 3 and the remains are 3; and 4 from 4 you cannot, which leaves 36 remains; which are feet, as in the margin; ſo the work is 4 ſquare and 36 feet. And in like manner is all diviſion of whole numbers wrought; at leaſt my method is ſo.

Example the Second.

9	675	75
	63	
	45	
	45	
	00	

Let 675 feet of dado, wainſcot, or any other ſuperficial work, that is meaſured by the yard, be brought into yards; therefore as 9 ſquare feet is a yard, we divide by 9; place them as in the margin, and proceed as before; ſeek how often 9 can be had in 67; why 7 times, which is 63; place down this under 67, then making a line under them ſubtract as before, ſaying, 3 from 7 and there remains 4, which place in the

the margin after this, bring down the 5, and place it next the 4 to the right hand, which makes 45 for a new dividend; then ſeek how often 9 can be had in 45; 5 times 9 is 45, which place under 45, the new dividend, and ſubtract as before, and your work is done, which is juſt 75 yards.

Note, If the dividend conſiſt of eight or ten figures, you muſt ſtill proceed till you have brought down all the figures in the dividend, as in the two foregoing examples. But ſee the following.

Let it be required to divide 876543 by 647.

E X A M P L E S.

49	564987	11530	647	876543	1353
	49			647	
	74			2295	
	49			1941	
	259			3544	
	245			3335	
	148			2093	
	147			1941	
	17			152	

LECTURE

LECTURE LXXII.

Of Contractions *in* Division.

WHEN the diviſor is 10, 100, 1000, or 10000, cut from the dividend the ſame number of figures to the right hand as there are cyphers in the diviſor; and the figures remaining to the left are the quotient required; ſo 6784 divided by 10, I cut off one figure to the right hand as in the margin, and the quotient is 678, and 4-tenths the remains.

1,0 | 678 | 4

And if 984367 ſquare feet was to be brought into ſquares, or divided by 100, I only cut off 2 figures to the right of the dividend, as in the margin, and the work is done, which is nine thouſand eight hundred and forty-three ſquares and ſixty-ſeven feet. But ſee theſe examples by the common way.

100 | 9843 | 67

Example 1.

```
10 | 6784 | 678
     60
     --
      78
      70
      --
       84
       80
       --
        4
        =
```

Example 2.

```
100 | 984367 | 9843
      900
      ---
       843
       800
       ---
        436
        400
        ---
         367
         300
         ---
          67
          ==
```

And ſo of 1000, and alſo of 10,000. The

The way to prove diviſion is to add all the products reſulting in the whole work together, in the ſame order as they ſtand in the work; the ſum of them (adding the laſt remainder, if any there be) ſhall be equal to the dividend. Or this way; multiply the quotient by the diviſor, and to the product add the remains if any, and if your work is true, it will be the ſame as the dividend.

LECTURE LXXIII.

DIVISION of DECIMALS.

AS diviſion of whole numbers is the hardeſt of the four ſpecies of vulgar arithmetic, ſo the diviſion of decimals is the moſt difficult of the four kinds of decimal arithmetic; but in this, as in the reſt of my undertakings, I ſhall endeavour to make it plain, eaſy, and familiar to the weakeſt capacity.

The general varieties that happen in diviſion of decimals are principally the following; firſt, to divide whole numbers and fractions; ſecondly, to divide whole numbers by mixt, or mixt numbers by whole; thirdly, to divide a greater fraction by a leſs; and laſtly, to divide a leſſer fraction by a greater. Diviſion of decimals is performed in every reſpect as whole numbers; only there is ſome difficulty in diſcovering the true value of the quotient; the following is a general rule.

The places of decimal parts in the diviſor, and quotient, being accounted together, muſt always be equal in number with thoſe in the dividend; and therefore as many figures as are cut off in the dividend, ſo many muſt be cut off in the diviſor and quotient. Or thus; cut off as many figures in the quotient as will make thoſe cut off in the diviſor

equal

equal to thoſe in the quotient; with this obſervation, that if there be not ſo many in the quotient, to add cyphers to the left hand, and alſo, that if your dividend be an integer, or have leſs cut off than is in the diviſor, to add cyphers to the dividend, till they are equal; this general rule admits of four caſes.

CASE I.

Example.

Where the places of decimal parts in the diviſor and dividend are both equal in number, as in the example in the margin, where both diviſor and dividend are mixed numbers, then the quotient will be all whole numbers.

```
45.326 | 5642.435 | 124
         45.3026
         -------
         11 0983
          9 0652
         -------
          2 03315
          1 81304
         -------
           22011
```

CASE II.

Divide 6458.271 by 573, as in the margin; here the dividend is a mixed number, and the diviſors are integers, and as here are three decimals in the dividend, and none in the diviſor, therefore cut off 270 the laſt 3 figures in the quotient, and the quotient will be 11.27.

```
573 | 6458.271 | 11.27
      573
      ----
      .728
      573
      ----
      1552
      1146
      ----
      4067
      4011
      ----
      .56
      ===
```

CASE

CASE III.

Divide .84 by .0324, as in the margin; here the dividend is whole numbers, and the divisor a decimal; and seeing that 84 the dividend consists but of two places, I therefore add two cyphers to it, making it 8400, thereby both dividend and divisor may be made fractions; and by their being both of equal number of places by case the first, the quotient is integers; when there are not so many places of decimal parts in the dividend as there are in the divisor, then annex cyphers to the dividend to make them equal, and the quotient will be all whole numbers as in case the first.

```
.0324 | .8400 | 26
         648
        ————
         1920
         1894
        ————
          126
```

CASE IV.

Divide 4653 by 645, as in the margin; now, here the dividend being integers, and the divisor a decimal, to bring out integers in the quotient I add 3 cyphers to 4653, the dividend, and the quotient is 412, and 120 remains; but if, after the division is finished, there are not so many figures in the quotient as there ought to be places of decimal parts by the general rule, then supply the defect by prefixing cyphers before the figures produced in the quotient, as, for example; divide .421563 by 24, now here the dividend is a decimal,

```
645 | 4653000 | 612
      3870
     ————
       7830
       7710
      ————
        120
```

mal, and the divisors are integers, whose quotient is .17545; but as there are places in the dividend, and but 5 in the quotient, therefore according to the general rule I prefix a cypher before the quotient 17545, making it .017545, which is the true quotient required.

```
24 | .421543 | .017545
     24
     ———
     181
     168
     ———
      135
      120
      ———
       156
       144
       ———
        123
        120
        ———
          3
```

From the preceding examples it may be observed, first, that when the dividend is superior to the divisor, the quotient is either integers, or decimals and integers; and lastly, that when the divisor is superior to the dividend, the quotient is a decimal; and which, in both cases, holds good in other examples.

LECTURE LXXIV.

Of Reduction.

Reduction is nothing more than a two-fold composition of multiplication and division, for the use of changing a quantity out of one denomination into another, as less into greater by multiplication; or, greater into less by division, as

as for example; if it were required to know how many ſuperficial inches were contained in 7264 feet, this is the rule; multiply the feet by the number of inches in a ſuperficial foot, and the product is the content required.

EXAMPLE.

```
   7264
    144
-------
  29056
 29056
 7264 .
-------
1046016
```

In 1046016 inches how many ſquare feet? Now to bring this to its former ſtate, you muſt divide by 144.

```
144 | 1046016 | 7264
      1008
      ----
        380
        288
        ---
         921
         864
         ---
          576
          576
          ---
          000
```

As there is no other difficulty in this rule but obſerving the denomination to which you are to reduce the given ſum or quantity, I ſhall not trouble my reader with any more examples of this ſort, but

conclude with the following observation, that when you would reduce squares, rods, yards, feet, or any other denomination, find out the two quantities, and the one reduce by division, the other by multiplication.

EXAMPLE.

To reduce squares into feet, multiply the number of squares by 100, the number of square feet in a square, and the product will be feet; and to reduce feet into squares divide by 100, and the quotient will be squares: to reduce yards into feet, multiply the yards by 9, the square feet in a yard will be the number of feet; and to reduce feet into yards, divide by 9; to reduce loads of timber to solid feet, multiply the loads by 50, the solid feet in a load of timber, and the product will be the contents; and to reduce solid feet into loads, divide by 50, the quotient is the load; and so of any thing else, whether money or measurement; but this rule is so obvious, that it needs no more instructions. I shall therefore proceed to the golden rule; or, rule of three in whole numbers.

LECTURE LXXV.

The Golden Rule: *Or,* Rule of Three Direct.

THIS is one of the most useful and most simple rules in arithmetic, and for its uncommon utility deserves a golden name; its use is when there are three numbers given to find a fourth, which shall have the same proportion with them as they have one to another; and is therefore properly called the

the rule of proportion. This rule is direct, indirect, and compound.

First, The single rule of three direct, finds a fourth number in such proportion to the third, as the second is to the first; or, as the second is to the first, so is the third to the fourth. But 4 numbers are in proportion, and called proportional, when as the first is to the third, so is the second to the fourth; as, if there were given 2, 3, and 4, to find a fourth, which may be to 3, as 4 is to 2, that is, double, and that fourth number is 6; and this is called the proportion direct; and the rule whereby it is done, the direct rule.

There is also another proportion which is called reciprocal; which is, when as the first is to the third, so is the fourth to the second; as 3, 4, 6, and 2, and is called the rule of three reverse; by direct proportion, the product of the two middle numbers multiplied together is always equal to the product of the first and last multiplied together, which serves not only as a proof, but as a ground of the rule, which rule shall here follow.

RULE.

Multiply the second term or number by the third, and divide the product by the first, the quotient shall be the fourth number required.

EXAMPLE.

Let the three numbers given be 2, 6, 3; multiply 6 by 3, the product is 18; then divide 18 by 2, the quotient is 9, which is the fourth number in proportion with 2, 6, and 3; for as 2 is to 3, so 3 times 2, which is 6, is to 3 times 3, which is 9;

 and

and ſo the product 18 divided by 2, and the quotient 9, cauſeth that the product of 2 into 9 ſhall be alſo 18; and conſequently, if 2 be the firſt of the four proportional numbers, and 6 and 3 the two middlemoſt, then 9 is the laſt.

RULE.

To know when to uſe the direct or the reverſe rule, conſider if more require more, or leſs require ſtill leſs, then uſe the direct rule: but if more require leſs, or leſs more, then uſe the reverſe rule. But this will be eaſily underſtood when we come to example.

EXAMPLE I.

If the diameter of one circle be 7, and its circumference 22, what is the circumference of another circle whoſe diameter is 14?

First, place your numbers as in the margin; ſecondly, multiply 14, the third number, by 22, the ſecond number; and divide their product 308 by 7, the firſt number; the quotient 44 is the fourth number, and the true anſwer required.

```
7 : 22 :: 14 : 44
          22
          --
          28
         28
         ---
   7 | 308 | 44
       28
       ---
        28
        28
        --
        00
        ==
```

When

When the fourth number is thus found, place it next after the third number, with two dots of ſeparation between them. The ſame kind of ſeparation muſt be obſerved between the firſt and ſecond; between the third place 4 dots. Theſe points of ſeparation bear this analogy, as $7 \overset{\text{is to}}{:} 22 \overset{\text{ſo is}}{::} 14 \overset{\text{to}}{:} 44$. The points are to expreſs the words as they are placed above them.

EXAMPLE II.

If the circumference of a circle be 22, whoſe diameter is 7, what is the diameter of another circle whoſe circumference is 44?

Here the nature of the queſtion requires the two firſt numbers to be placed the reverſe of the foregoing example; for as there the fourth number required was the circumference of a circle, ſo here on the contrary the diameter of a circle is required; but the manner of working, by multiplying the third number by the ſecond, and dividing by the firſt, is the ſame here as before, as is ſeen in the margin, where the quotient 14 is the diameter required.

```
22 : 7 : 44 : 14
          7
        ----
22 |   308 | 14
        22
       ----
        88
        88
        --
         0
        ==
```

Now as in both theſe and all other examples in the rule of three direct, the fourth number is always equal to one more than the ſecond; ſo in the rule of three indirect, the fourth number is always leſs than the ſecond: — and as the fourth number in the direct rule is found by multiplying the ſe-
cond

cond and third numbers together, and dividing their product; so, on the contrary, in the indirect rule you multiply your first and second numbers into one another, and divide their product by the third, as follows.

EXAMPLE III.

If 10 men can perform a certain quantity of work in 30 days, how long time will 20 men be in performing the same?

RULE.

Multiply 30, the second number, by 10 the first, and their product, which is 300, divide by 20, and the quotient, which is 15, is the answer required.

```
men   days     men days
10  :  30   ::  20 : 15
       10
      ----
20 |  300  | 15
       20
      ----
      100
      100
      ----
        0
       ==
```

Of Golden Rule Compound.

In the golden rule compound there are always five numbers given to find a sixth in proportion thereto; which numbers must be so placed as that the three first may contain a supposition, and the two last a demand; and that you may place numbers

bers truly, always obſerve that the firſt number be of the ſame denomination with the fourth, the ſecond of the ſame denomination with the fifth, and the third with the ſixth required.

EXAMPLE.

If 8 men in 36 days lay 48 ſquares of flooring, how many ſquares can 6 men perform in 28 days?

RULE.

Firſt, ſtate the queſtion as below; ſecondly, multiply the two firſt numbers, viz. 36 into 8, whoſe product is 288, as alſo the two laſt is 168.

Men	Days	Men	Days
8 :	36	6 :	28
	8		6
	288		168

Now the anſwer to this is found by rule of three direct, by making 288 (the product of the firſt two) the firſt number; the third given number, 48 ſquares, your ſecond; 168 (the product of your laſt) your third number.

```
288 : 48 : 168
             48
          ------
          | 1344 |
           672
          ------
   288 | 8064 | 28
          576
          ------
          2304
          2304
          ------
            00
```

The anfwer is 28, which is 28 days, which is equal to 8 men in 36 days.

To prove the Golden Rule.

As the four numbers are proportionals, that is, the fourth is to the fecond as the third is to the firft, therefore the fquare of the two means, (which are the fecond and third) are always equal to the fquare of the two extremes, (that is, the firft and the laft;) that is to fay, if the product of the firft and the laft numbers, multiplied together into each other, be equal to the product of the two middles, the work is right, elfe not.

So 8064 the product of

288	168
28	48
2304	1344
576	672
A | 8064 |	B | 8064 |

168 multiplied into 28, which are the two extremes of the above example, as at A, is equal to 8164, the product of 28 multiplied at 288, the two extremes of the same example, as at B; hence it is plain, that when the given numbers in the foregoing three varieties of the rule of three are truly stated, (and which, indeed, is the only difficulty in the whole) the manner of performing the operation is very easy.

LECTURE LXXVI.

The EXTRACTION *of the* SQUARE ROOT.

EXtracting the square root is no more than finding the side of a geometrical square, whose area is the side multiplied into itself. For example: 25 is a square number, which is produced by 5 being multiplied into 5; so in like manner 16 is a square number, produced by 4 multiplied by 4. The side of any geometrical square is called its root. I have added a table of square numbers, whose roots are the nine digits, and which, being nothing more than part of the multiplication table,

I doubt not by the time you have got thus far, but you have got it by heart.

E X A M P L E.

Let 625 be a root given to find its ſquare root.

1	1
2	4
3	9
4	16
5	25
6	36
7	49
8	64
9	81

R U L E.

Multiply 625 into itſelf, as at b c, whoſe product is 390625, the ſquare number required, and whoſe root is thus extracted, viz. Firſt, place a point above the firſt figure to the right-hand as at n, and at every other figure to the left-hand as at d and e, and obſerve as many points as this ſquare number contains, ſo many places of figures the root will conſiſt of. Secondly, make a crotchet at the right-hand of the ſquare number as in diviſion; and note, that every two figures ſo pointed are called a punctuation. Thirdly, find in the table the neareſt

square number that is contained to the left-hand viz. in 39, which is 36, whose root is 6, place 36 under 39, and its root 6 in the quotient, and subtracting 36 from 39, the remains are 3, which place under 36, as in the example; this is your first work, and is no more to be repeated. Fourthly, bring down the next punctuation 06 and join it to the remains 3, making 306, which is your first resolvend, and on its left-side make a crotchet as in division, to separate

```
        c 625
        b 625
        -----
         3125
        1250
       3750
       ---------
       e  d  n    f
       390625 · | 62 5
       36
    p h -------
   12. 2 | 30.6 g
           24 4
          ------
   124.5 | 6 22.5
           6 22 5 x
          --------
           0 00 0
```

the divisor from the dividend. Fifthly, double the root 6, which makes 12, which place at the left of the resolvend, as at p; then rejecting the last figure in the resolvend, which must always be done as at g, see how often the divisor 12 is contained in the remaining two figures in the resolvend, which is twice, therefore place 2 in the quotient at f, and also at the right-hand of the divisor as at h, and multiply 122, the divisor, increased by 2, that is by the 2 in the quotient, the product is 244, which place under 306 the resolvend, which being subtracted from it, the remains are 62; this being done, bring down the next punctuation, and join it to the remainder 62, make it 6225 for a second resolvend,

resolvend, and then proceed as before, viz. double the quotient 62, which makes 124, which place on the left of the second resolvend; then see how often 124 is contained in the last resolvend, the last figure as before rejected, it is 5 times, place 5 in the quotient, and also to the right of the last divisor; then multiplying the divisor by 5 as before, placing the remains under the resolvend as at x; then subtracting from the resolvend, you will find no remains, which shews that 390625 is a square number, whose root is 625 required.

Note, if the square number consists of more punctuations, you must still bring them down, and proceed in every respect as before. Secondly, if at any time, where you have multiplied the number standing in the place of the divisor by the figure last found in the quotient or root, the product be greater than the resolvend; then, in such a case, you must put a figure less by one than the former in the quotient, and multiply by it as before. Thirdly, if at any time the divisor cannot be had in the resolvend, then place a cypher in the quotient, and also on the right-hand of the divisor, and to the resolvend bring down the next punctuation for a new resolvend, with which proceed as before. Whenever it happens after extraction is made, there is a remainder, the number given is called a surd or irrational number, and its root cannot be exactly obtained, although by adding a cypher you may come as near the truth as possible.

EXAMPLE.

EXAMPLE.

If it is required to extract the root of 160, the firſt punctuation here being 1, the ſquare of one is 1, which place under 1, ſubtracting 1 from 1 remains 0, ſet 1 in the quotient, and to 0 bring down the next punctuation 60, making the remains 060. Secondly, double the quotient 1 makes 2, which place for your diviſor as in the laſt example; now as 2 is contained three times in 6, after rejecting the 0 as before taught, being the laſt figure in the reſolvend to the right-hand; I ſay, to place 3 in the quotient and diviſor would make the latter 23, which multiplied by 3 would be 69, which is more than 60, the firſt reſolvend, and cannot be ſubtracted from it; therefore, in ſuch a caſe as I have before ſtated, place a figure leſs but one in the quotient, that is 2, and alſo the ſame on the right of the diviſor 2; then multiplying the diviſor 22 by 2 in the quotient, the product is 44, which being placed under the firſt reſolvend 60, and ſubtracted from it, the remains is 16. Thirdly, to the remains, annex two cyphers, and make it 1600 for a ſecond reſolvend; and then, proceeding as before, the next figure in the quotient will be 6, and 124 remains, to which annex two cyphers more, making the remains 12400 for

	160	12.649
	1	
22	060	
	44	
246	1600	
	1476	
252.4	12400	
	10096	
2528.9	230400	
	227601	
	2799	

for a third resolvend, and proceed in like manner by continually adding two cyphers every time to each remainder till you have increased the figures in the quotient to as many places as may be required; in this I have increased them to three places, which I apprehend to be near enough for any business.

If it is required to extract the square-root of 4096.

EXAMPLES.

4096 | 64 36 124 | 49.6 49 6 00 0	678960 | 823 64 162 | 38.9 32 4 1643 | 656.0 492 9 163 3
676 | 26 4 46 | 27.6 27 6 00 0	57284 | 238 4 43 | 17.2 12 9 468 | 4 384 3 844 540

LECTURE

LECTURE LXXVII.

The EXTRACTION *of the* CUBE-ROOT.

A Cube number is that number which is produced by multiplying any number into itself, and its product again by the same number, so 64 is a cube number, produced by 4 multiplied in 64.

A cube is a solid figure, contained under six equal squares, and may fully be represented by a dye.

Of cube numbers there are three distinct kinds or species, viz. single, compound, and irrational. First, such are called single cube numbers which are made of any one single number, or significant figure multiplied twice into itself, as 1 multiplies nothing, and is both root and cube; but, 2 times 2 is 4, and twice 4 is 8. so that 2 is the root, and 8 the cube; also 3 times 3 is 9, and 3 times 9 is 27, here 3 is the root, and 27 the cube; and so of all the 9 diget numbers, as in the following table.

EXAMPLE.

1	multiplied into itself produceth the square numbers,	1	and that multiplied again into the side produceth the cube numbers.	1
2		4		8
3		9		27
4		16		64
5		25		125
6		36		216
7		49		313
8		64		512
9		81		729

Com-

Compound cube numbers are thoſe whoſe roots conſiſt of more figures than one, as if 12 was the the root, then 12 times 12 is 144 the ſquare, and 12 times 144 is 1728, which is a foot cube of timber, &c.

Irrational cube numbers are thoſe whoſe exact cube cannot be found either by whole numbers, fractions, or decimals.

EXAMPLE.

Let 262144 be a cubed number given to find its root. Firſt, point the firſt figure to the right-hand, then every third figure towards the left-hand as at b d. Secondly, look at your table of cubed numbers, and find the nearest cube number to 262, which is 216, whoſe root is 6, place 6 in the quotient, and 216 under 262, and ſubſtracting 216 from 262, the remains are 46; bring down the next pnnctuation 144, and annex them to 36, making it 36144, which is your firſt reſolvend. Now to find a diviſor by which you are to divide this reſolvend, its two laſt figures excepted, which muſt always be done, proceed in the following manner, viz. Firſt, ſquare the quotient 6, which is 36, which treble makes 108, and is the diviſor required as at r; then ſeek how often you can have 108 in 461, rejecting the two figures to the right, as obſerved 4 times, which is equal to 432, which place

```
          d  b
          .  .
        262144 | 64
        216
    r   ------
  108 | 46144 Reſolvend.
      u 432
         288 w
          64
        ------
        46144
        ------
        00000
```

place under the reſolvend as 461 as at u, and ſet 4 in the quotient. Secondly, treble 6 the firſt figure in the root equal to 18, which multiplied by 16, the ſquare of 4, the laſt figure in the quotient makes 288, which place under 432, one place to the right-hand as at w; alſo cube 4, the laſt figure in the quotient, which is equal to 64, which place under 288, one place more to the right hand, as at r; then the three ſubducends 432.288, and 64 being added together as they ſtand, their ſum make a ſubtrahend 46144, which being ſubtracted from the firſt reſolvend, their remains are nothing, which ſhews that 262144 is a cube number, whoſe part is 64.

EXAMPLES.

```
     110592 | 49
     64
     ------
48 | 465.92
     432
      972
       721
     ------
     53641
     ------
      2951
```

```
       146363183 | 527
       125
       ------
  75 | 213.63
       150
         60
          8
       ------
       15608
       ------
8112 | 5755.183
       5678 4
         76 44
            343
       ------
       5755183
       ------
       0000000
```

E X A M P L E S.

103823 | 47
64
———
48 | 398.23
336
588
363
———
39823
———
00000

117649 | 49
64
———
48 | 536.49
432
972
729
———
53649
———
00000

110592 | 48
64
———
48 | 465.92
38 4
7 68
492
———
4 6572
———
00020

L E C T U R E LXXVIII.

Of MENSURATION.

MY reader muſt obſerve of the following treatiſe, that every quantity is meaſured by ſome other quantity of the ſame kind, as a line by a line, a ſuper-

a ſuperficies by a ſuperficies, and a ſolid by a ſolid; and the number which ſhews how often the leſſer, called the meaſuring unit, is contained in the greater, or quantity meaſured, is called the content of the quantity ſo meaſured, thus; if the quantity to be meaſured be a ſuperficies, whoſe dimenſions is 8 inches by 6 inches, and the meaſuring unit an inch each way; then as many times as the unit is contained in the above rectancle, which much be 8 times 6, viz. 48 which is the number of ſuperficial inches contained, from whence it is eaſy to conceive, that any ſquare or rectangular figure may be found by repeating the number of parts into which the length is divided by the ſide of the meaſuring unit, as often as there are parts in the breadth of the ſame, whether inches, feet, yards, ſquares, &c. for it is in familiar ſpeaking but multiplying one ſide by the other, and the product is the area required of all regular figures.

How to meaſure the area of a triangle,

R U L E.

Multiply the baſe by half the perpendicular; let fall or ſtruck ſquare from the baſe, or what is called the hypothenuſe, to the point of the right angle, and the product is the content required. Suppoſing the baſe of a triangle 25, half the perpendicular let fall 9, I multiply them as in the margin, and the product is the content required.

$$\begin{array}{r} 25 \\ 9 \\ \hline 225 \end{array}$$

To find the content of a trapezium-figure, whose ſides are parallel, though of an unequal length.

RULE.

Add the two ſides together, and take half for the length; multiply that by the width, the product will be the content required. Suppoſing the 2 ſides added together was 54, the width of the plain 16, I place them as in the margin, and the product in the content required.

27
16
162
27
432

To find the content of any unequal-ſided figure.

RULE.

Divide it into triangles, and meaſure it as before taught; then add the ſeveral ſums together, which will be the content required.

Having ſhewn how any right-lined ſuperficial figure may be computed, it may be proper to ſay ſomething with regard to the area, and circumference of a circle.

It is well known, that to determine the true area of a circle, and to find a right line exactly equal to the perephery or circumference thereof, have been looked upon by mathematicians as abſolutely impoſſible; therefore I hope the learner will be content with ſuch methods as will be near enough to approximate any thing required in the building branch,

branch, and ſuch as have been thought near enough, not only by Archimedes, but every author ſince.

LECTURE LXXIX.

Of CIRCLES.

THE diameter of a circle being given to find its circumference.

RULE.

As 7 is to 22, ſo is the diameter to the circumference. Suppoſe the diameter be 9 feet, firſt multiply the diameter 9 by 22, the product is 198, which divided by 7 gives 28 feet and 2-7ths of a foot for the circumference.

```
      22
       9
    ----
 7 | 198 | 28
     14
    ----
      58
      56
      --
       2
      ==
```

The circumference of a circle being given, to find the diameter.

RULE.

Multiply the circumference by 7, and divide by 22, the quotient will be the content required.

The

The diameter of a circle being given, to find the area, or ſuperficial content.

RULE.

As 7 is to 22, ſo is the ſquare of the ſemi-diameter to the ſuperficial content.

Suppoſing the ſemi-diameter was 4 feet, that ſquared is 16, multiplied by 22 gives 352, and that product divided by 7, the quotient is 49 feet, the area of the circle required.

```
       16
       22
     ----
       32
      32
     ----
  7 | 352 | 49
      28
     ----
       72
       63
       --
        9
```

How to meaſure any part or portion of a level.

RULE.

Multiply half the arch-line by the ſemi-diameter, and the product will be the ſuperficial content.

To

To find the ſuperficial content of a cilinder.

RULE.

As 7 is to 22, ſo is the diameter and length of the ſide multiplied one by another, to the ſuperficial content of the outſide of the cilinder. Suppoſing the diameter was 5, and the length 12, thoſe multiplied together make 60; and again multiplied by 22, the product is 1320, which divided by 7 gives 188 feet, the ſuperficial content.—— Note, This may be done by girting the cilinder for the width multiplied by the length.

```
     12
      5
    ---
     60
     22
   ----
    120
   120
   ----
7 | 1320 | 188
    7
    -
    62
    56
    --
     60
     56
     --
      4
```

To meaſure the ſuperficies of a dome or globe.

RULE.

Multiply the diameter by the circumference, and the product is the content required.

How

How to measure a pyramid.

R U L E.

Add all the four sides of the base together, and take half the sum multiplied by the height, which will be the superficial content required.

LECTURE LXXX.

Of Solids.

Solid figures or bodies are such as consist of three dimensions, as length, breadth, and thickness, as stone, timber, earth, or any other solid body whatsoever. The difference in the measurement of superficies and solids is this; in the former you have only to measure the length by the breadth; in the latter you have to multiply that product by the thickness, by the following example.

Supposing a cubical figure was 1 foot 6 inches by 1 foot 6 inches, and 2 feet deep, first I multiply 1 foot 6 inches by 1 foot 6 inches by duodecimals, and the product by 2 foot, the depth, the content is 4 ½ feet of solid content.

ft.	in.	
1	6	
	1	6
	9	0
1	6	
2	3	0
	2	
4	6	

All

All regular solid bodies that are above a foot in the square may be measured by duodecimals, being much the simplest and readiest method.

Supposing a piece of square timber was 2 feet 6 inches by 1 foot 3 inches, and 9 feet long.

EXAMPLE.

First multiply 2 feet 6 inches by 1 foot 3 inches, and that product by the length, the last product will be 29 feet 7 inches 6 parts, the content required.

ft.	in.	
2	6	
	1	3
	7	6
2	6	
3	3	6
		9
29	7	6

To measure the solid content of any scantling of timber under a foot.

Multiply one side by the other, that is, squaring one end, and multiply that by 12 gives the solid inches in one foot long; after multiply that product by the number of feet the piece contains in length, and the product will be the content in inches; after divide by 728, the cubical inches in a foot, and you will have the solid content in feet.

EXAMPLE.

Suppoſing a piece of timber the ſcantling of which was 8 by 3, I ſay, 8 times 3 is 24, and multiply that by 12 gives 288 ſolid inches, the length 25 multiply into 288, and divide by 728, gives 9 ſolid feet of timber, and 648 ſolid inches, which is ſomething leſs than a quarter of a foot.

```
            3
            8
            —
           24
           12
         ————
          288
           25
         ————
         1440
         576
         ————
728 | 7200 | 9
      6552
      ————
       648
```

To find the ſolid content of a pyramid.

RULE.

Firſt find the ſuperficial content of the baſe, or biggeſt end, and that product multiplied by one third of the height, the product will be the ſuperficial content. The ſame if the baſe was a triangle.

LECTURE

LECTURE LXXXI.

Of Meaſuring ROUND TIMBER.

IT is cuſtomary in meaſuring round timber, if a tree is regularly ſhaped, to girt it in the middle with a ſtring, for a mean between the two ends; then the ſtring muſt be doubled four times for the girt. So if a tree is in circumference 32 inches, the girt is 8 inches.

RULE to meaſure it.

Square the girt, and multiply that by 12, and the product by the length, and divide by 1728, you have the content required, as in the margin, which is 11 ſolid feet and 192 ſolid inches, which is near ¾ of a foot.

8
8
—
64
12
—
768
25
—
3840
1536
—
1728 | 19200 | 11
1728
—
1920
1728
—
192

Note. If the timber girt be above a foot, you may measure by duodecimals, which is much the best and easiest method. See the following

EXAMPLE.

Suppose a piece of round timber or stone girt 1 foot 3 inches, first I square that, and multiplying the product by the last product, I find the content required to a length of 8 feet; and so of any other dimension.

1	3	
	1	3
	3	9
1	3	
1	6	9
		8
12	6	0

LECTURE LXXXII.

Of GEOMETRY.

GEOMETRY is that science by which we compare all quantities together that have extension, being the basis of building, and on which almost every art depends.

Geometry is both speculative and practical; the former elucidates the properties of lines, figures, and angles; the latter teaches how to apply or reduce them to practice in architecture, &c.

Extension is considered by length, breadth, and thickness.

A line is that which hath length without breadth. The bounds of a line, or extremes, are called points, and have no magnitude or extension to be divided to our sight. When extension called quantities

quantities are conſidered as lengths, only they are called lines. Thoſe with lengths and breadths are called ſurfaces. A right-line is that which lies evenly between its extremes, or every where tends the ſame way. An angle is the opening or inclination of two right-lines meeting each other in a point.

An acute angle is that which is leſs than a right angle. An obtuſe angle is that which is greater than a right angle. Two right lines are ſaid to be equidiſtant, when perpendiculars are any way taken, and are of equal length.

A right lined plain figure is that whoſe bound are right lines.

All plain figures bounded by three lines are called triangles.

A right-angled triangle is that which has one right angle, whereof the ſide oppoſite to the right angle is called the hypothenuſe.

An equitateral-triangle is that whoſe ſides are all equal.

A ſcalene-triangle is when all the three ſides are unequal. A rectangle is a ſquare whoſe ſides and angles are equal.

Alſo, a parallellogram, whoſe angles, if right, are called rectangles.

A trapezium is an irregular four-ſided ſquare.

A circle is a figure bounded by one line, called its perephery or circumference.

Every right line paſſing through the center of a circle, and terminating in the circumference, is called a diameter.

An arch of a circle is any portion of the perephery or circumference.

The cord or ſuſtence of an arch is a right line joining the two extremes of that arch.

A ſeg-

A ſegment of a circle is a figure contained under a ſemi-circle.

A ſemi-circle is a figure contained under any diameter, and the part of the circumference cut off from that diameter.

A ſector of a circle is a figure contained under two right lines drawn from the center to the circumference.

The radius of a circle is the diſtance of the center from the circumference.

Theſe figures and bounds mentioned are part of one of the great principles of geometry, being diſtinguiſhed into three parts, viz. poſtulates, axioms, and definitions. The former being demands or ſuppoſitions, intimate, that from any given line or point another right line may be drawn.

That from any center or diſtance, or with any radius, the circumference of a circle may be deſcribed.

Alſo, that the equality of lines and angles to others given be granted as poſſible for one right line to be perpendicular, or parallel to another, at a given point or diſtance; and that every magnitude hath its half, quarter, third, fourth, &c.

The ſecond principle are axioms or ſelf-evident truths, as every whole is greater than its half.

That every whole is equal to all its parts.

Alſo, if to equal things equal things be added, the whole muſt be equal.

All right-angles are equal to each other, if from equal things equal things be taken, the remains will be equal.

The third and laſt principle is definitions, which are the explications of ſuch terms, figures, and words, as concern a propoſition in order to render it intelligible and plain to the undertaking, that

every

every objection in demonstration may be comprehended without difficulty.

By a proposition is understood something proposed to be done or designed.

Also, when a problem is named, something is proposed or intended to be done.

A theorem is when something is offered for demonstration.

A lemma is a premise demonstrated with a view to render what follows, and what was first intended more plain.

A scholium is, when remarks or observations are ade upon something going before. A corollary is a truth gained from some preceding consequent truth or demonstration. The proper design of a definition being to shew and explain the term or thing designed, so as to give a precise and competent idea thereof, it is certain the exact meaning of every term made use of in a definition ought to be perfectly understood, or at least should be better known or more commonly received than the term to be defined. It was from this motive, that I have made free to nominate some of the principles of geometry, in order to animate the student to the search of it, which, if pursued with vigour, will give such satisfaction from the justness of its reasoning, as is only peculiar to the subject, and create a thirst for the spirit of its profundity.

Having said so much, and extended the volume beyond its intended size, I must beg my readers pardon for any mistakes committed either through deficiency of language, or the errors of the press, and turn his thought upon the extension and real meaning of the subject, and I hope he will at least acknowledge my intent was good, and if those who may

may be unacquainted with many of the matters ſpoken of, will but take upon themſelves to ſtudy as much for their own advantage as I have done for the general benefit of mankind, I am perſuaded they will not think their labours loſt.

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